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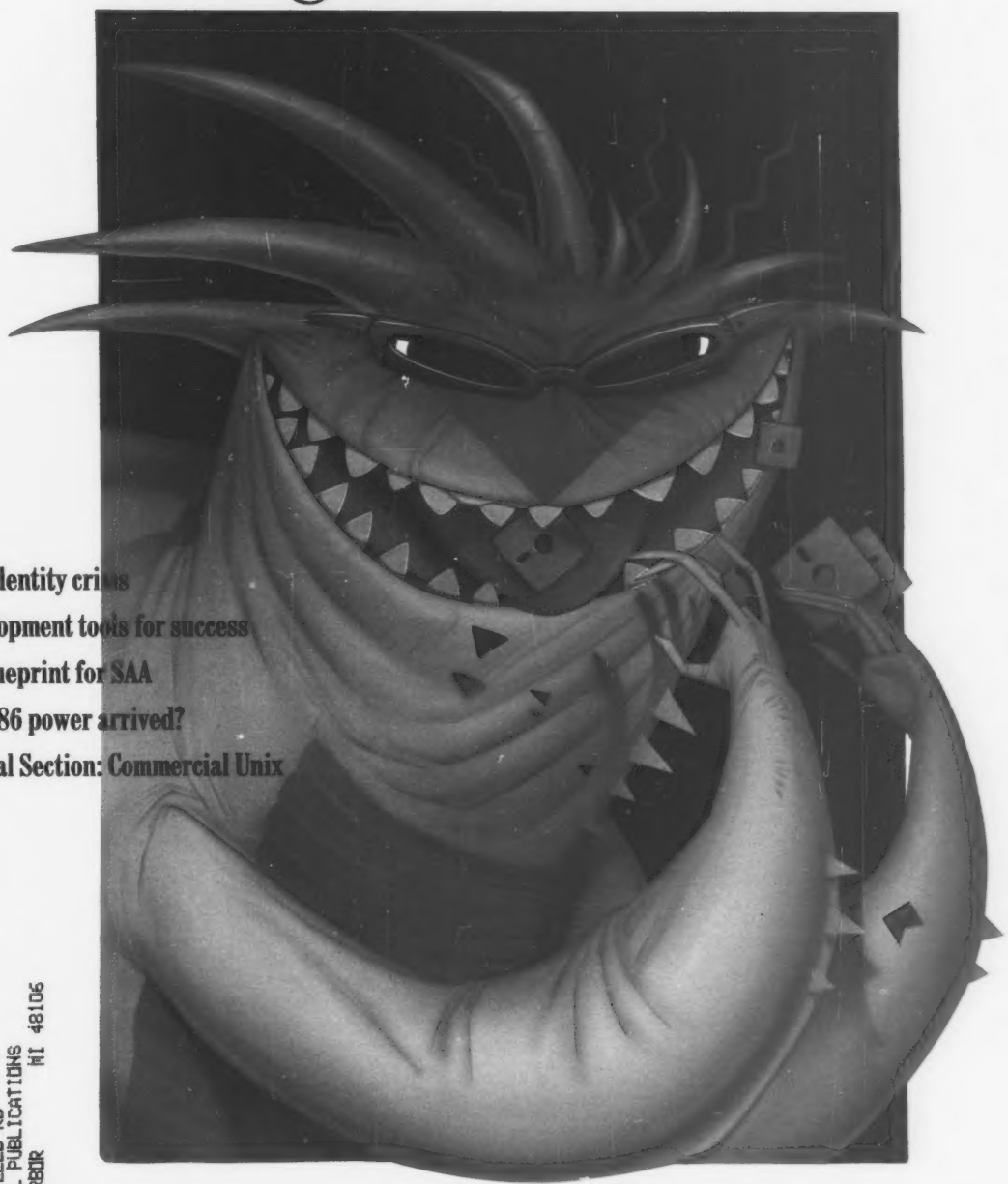
Taming the software beast



- 4GL identity crisis
- Development tools for success
- No blueprint for SAA
- Has 386 power arrived?
- Special Section: Commercial Unix

How to gain an applications advantage

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in focus

CLOSER, AND CLOSER STILL

Everyone knows about the Intel 80386 chip and the power it will eventually wield. But while the wait is on for software that will allow the microprocessor to really show its stuff, MIS knows that business demands and competitive decisions can't be put on hold. These professionals are instead opting for solutions that are available now, such as 386-based servers, which make the most of what the chip has to offer. Read about these servers and how they are helping MIS keep corporations moving forward. By Avery Jenkins. *Page 14.*

NO BLUEPRINT FOR SAA

IBM's goal for its Systems Application Architecture is certainly a noteworthy one — to provide consistency, portability and interconnection among its systems platforms. However, as the author sees it, SAA is currently only a jumble of products and interfaces without a grand design to pull them all together. It is this "poverty of substance" in SAA that gives IBM users the right to ask some tough questions of their vendor. By Tony Percy. *Page 19.*

The fate of 4GLs

By Stan Kolodziej. Fourth-generation languages are going through a crisis of sorts. Some opponents say that these tools have not fulfilled the promise of end-user computing. Others say they feel these languages have plenty of room to improve on Cobol. Whatever side of the argument you fall on, find out what appears to be in store for the fourth-generation language market. *Page 25.*

Development tools

By George Schussel. Strategic applications development at all levels — from mainframe programmer to end user on a workstation — is only as successful as the tools the developer uses. The author offers a guideline to software selection and some suggestions that can get your staff's creative juices flowing. *Page 32.*

SPECIAL SECTION

Commercial Unix

It's 1988, and commercial, MIS-oriented Unix actually exists, carried into mainstream business computing on the backs of small systems vendors. Features Editor Michael Tucker takes a hard look at this phenomenon and its repercussions for information systems professionals. Plus: Stories on what IBM's plans are for Unix and the rivals to Unix's position. Section begins on page 29.

From the Editor
Including your letters to us. *Page 5.*

Manager's Corner
Jim Young on putting the fun back into computing. *Page 6.*

Q&A
A data base consultant discusses the data administration function and its ties to business dealings. *Page 6.*

News & Analysis
Duplicating the Micro Channel; ADAPSO decries IBM/Fujitsu code deal; better user interfaces; Amdahl's Aspen axed; Unisoft, Motorola Unix binary standard. *Page 9.*

Blue Beat
Deidre Depke on IBM's software promotion tactics. *Page 35.*

Products
Tech Talk on Sun's Sparc; very large-scale network CASE system; natural language interface for Sybase data base. *Page 35.*

Calendar
Industry events. *Page 38.*

The Insider
Michael Millikin on what happened to end-user programming. *Page 40.*

Log Off
Why your peers use outside consulting services. *Page 40.*

COVER BY BILL MAYER

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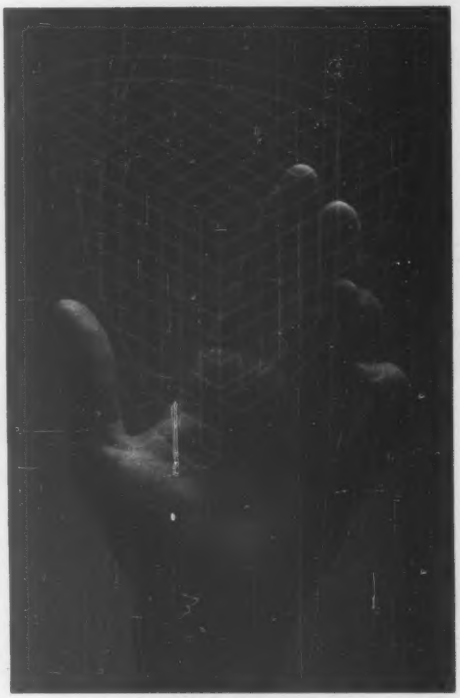

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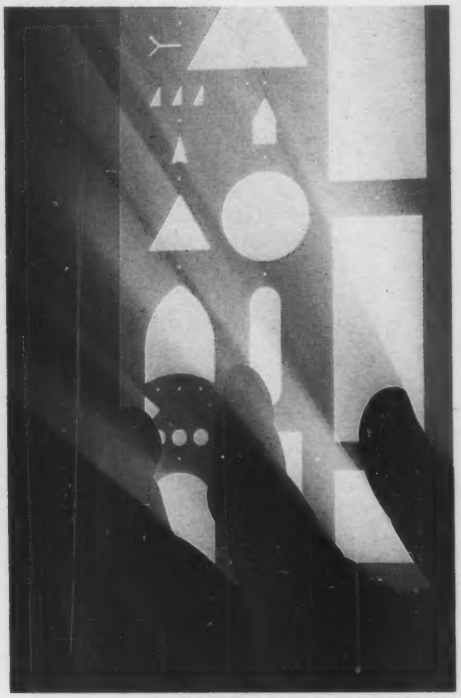

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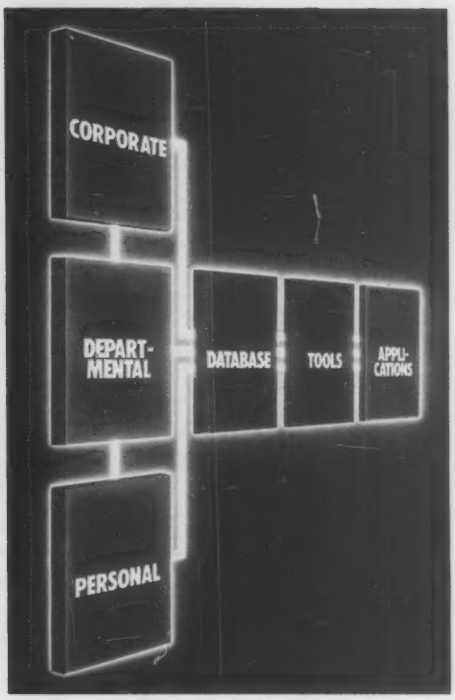

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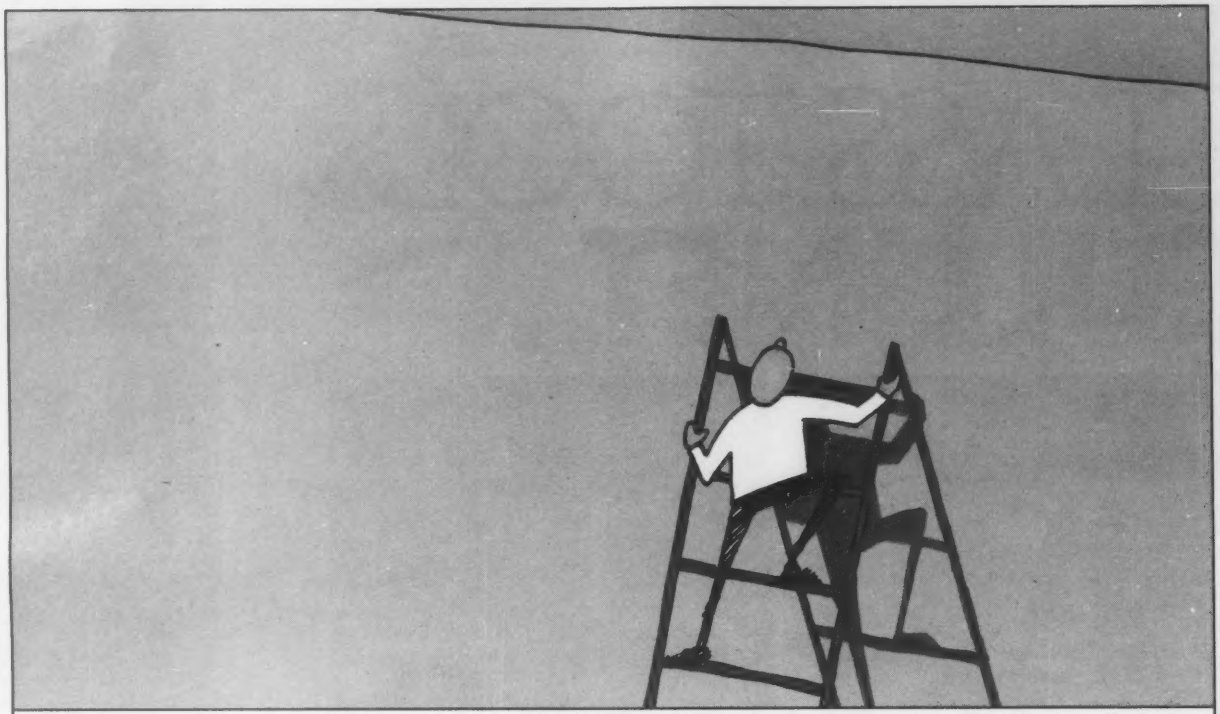

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FROM THE EDITOR

Teach your pupils well

Help Wanted: Computer scientists. According to U.S. colleges, the number of students pursuing a computer science degree is plummeting. Only a few short years ago, there were not enough courses to satisfy student or employer demand; today, students don't seem as interested in pursuing this job market. But employer demand does not seem likely to slacken. While we may still consider the MIS profession a young one, many of its managers are growing older. The largest group of *Focus* readers is in its early to middle forties. What will happen if entry-level computer science graduates are not available? A recent University of California study of college freshmen's plans showed that only 1.9% will major in computer science, down from 4.5% in 1983. Those seeking careers as computer programmers and analysts totaled 3.5%, down from 8.8% in 1983.

Why would today's career-oriented students bypass an assured job after graduation? Look at what's happening in business. As end-user computing spreads throughout organizational structures and departmental computing becomes more common, students may follow a new career path rather than the traditional MIS one. Instead of specializing within MIS — say in network management or systems development — they may choose a career path combining marketing and MIS, for instance.

Certain academic institutions are reflecting this change. There is a university in Boston that no longer teaches Basic and is considering dropping Cobol courses. It is, however, changing its discipline to allow students to specialize in such areas as marketing and DP, for example. Many schools are struggling with the difficulty of providing students with a curriculum that will attract their interest while still providing a complete education that will make them employable. These institutions need to decide if the more traditional course load is as relevant as some of the newer courses that reflect the way the industry is going.

Even if the trend to educate MIS for end-user departments continues, the fact remains that the technical skills and knowledge of a straight computer science degree are still essential. MIS is and always will be called upon for long-term planning, strategic direction, companywide integration, purchasing and maintenance. As an industry, we must continue to find expertise to fill the gap.

Ann Dooley

Every copy you make, every law you break, I'll be watching you

In the Dec. 2, 1987 issue of *Computerworld Focus*, Thomas Roberts in his column, "The absence of ethics," states his alarm that graduate students from the "East Coast's top business schools" are not aware of the criminal (and potentially civil) consequences of making unauthorized copies of software. Please permit me to set Mr. Roberts' mind at ease. Although the graduates of these MBA programs may not be aware of these consequences upon graduation, they may find out the hard way in the real world.

LETTERS TO THE EDITOR

As a professor of computer law at Fordham University School of Law, I can assure you that I am training a new generation of lawyers that not only will be familiar with the consequences of making unauthorized copies of software but will also be prepared to prosecute infringement claims on behalf of their clientele.

Watch out MBAs; computer JDs will be watching you.

Dennis S. Deutsch
Adjunct Associate Professor of Computer Law
Fordham University School of Law
New York

Deja vu: Reader claims WISC technology is nothing new

I just finished reading the news article by Features Editor Michael Tucker entitled "Back to basics: First there was RISC, now there's WISC" [*CW Focus*, Dec. 2, 1987]. It is apparent that you have not done your homework very well, because if you had, you would not be touting this so-called writable instruction set computing (WISC) as something new and wonderful.

WISC is actually a very old concept. In the early '70s, a number of minicomputers, such as the Microdata Corp. 32/S, provided a feature called Writable Control Store, which allowed users to tailor instructions to their needs.

Most notable is the Burroughs Corp. B1000 line. This line of machines featured variable instruction sets tailored to the application language, such as Cobol or Fortran, and allowed full virtual memory and multiprogramming of programs using different instruction sets. This was accomplished by using microcoded interpreters, operating in random-access memory, which were paged in and out dynamically. A high-level microcode language compiler, called Microcode Implementation Language, or MIL, was available for users with special requirements. This machine was highly successful, and many thousands have been sold during the last decade or so.

In closing, I would just like to ask that you do a better job of research and give some deserved credit to the earlier technological pioneers rather than giving exposure to copycat newcomers.

J. Keith Baker
Software Engineer
Unisys Corp.
Paoli, Pa.

Michael Tucker responds:
The final paragraphs did note that there was nothing new about WISC as a technology and that the technology, in fact, reflected a very old tradition of "right-to-the-hardware" programming. The fact that this technology exists and was long the mainstay of minicomputers is well known. The point of the article was simply that this appears to be the first time that WISC has been made available to developers working at the personal computer level.

MANAGER'S CORNER

MIS tries to recapture a feel-good philosophy

Jim Young

Sometimes, when you least expect it, the truth sneaks up and startles you. That was certainly the feeling I got while reading Carol Anderson's editorial in *New England Computing* last October entitled "Are We Having Fun Yet?"

In the article, she asserted that the fun has gone out of computing, and the statement rang true. Not only have we progressed past the fun and pleasure that used to be a major part of MIS work, but the associated enthusiasm of old is also missing.

Some of this attitude may be the dues we pay for lowering the barriers to our skills and mingling with those we support. For reasons of effectiveness, our profession is trying to be more businesslike and approachable. Certainly, some of the fun was found in being a small, elite group.

MIS may have given up some pleasure when the pioneering of early computing gave way to proven concepts and repetitive procedures.

The thrill of technical challenges evaporated, and the straitjacket of standardization took away a lot of our individual creativity. Moreover, technology became so approachable that even nonspecialized users could embrace it, and it ceased to be precious or worthy of a priestly cult any longer.

A sense of independence

There are clearly motivations for past joviality that have irrevocably changed along with our profession; for better or worse, they can never be recaptured. Yet other, more retrievable factors also caused our past high spirits. People say they remember getting more individual satisfaction from their labor. This flowed from a feeling of ownership of technical efforts and a spirit of special identity that is all too often missing today. A sense of independence fueled MIS's self-confidence; bureaucracy and management controls had not yet been spawned by complex megasystems. Pressure was more self-imposed than mandated.

Identifying the valuable causes of enthusiasm is more than just an exercise in nostalgia; it may give MIS the tools to resurrect this era of good feeling. If we could leave out the professional priggishness, perhaps we could regain some of the vitality that used to accompany computer technology. The high spirits and optimism generated energy, motivation and confidence — all the ingredients for creativity and productivity.

For this reason, enthusiasm is highly beneficial to our professional well-being. I suspect it is therapeutic for our personal well-being as well. A positive attitude further breeds success through its influence on others. Peers tend to rally toward demonstrated professional confidence. Users find a positive approach contagious and, through transference, endow related systems with trust and admiration. Enthusiasm even plays a role in generating top management support through the attention it draws and the upbeat outlook it presents. Far from being all dollars and cents, top management is quite familiar with the importance of a champion's personal persuasion.

If enthusiasm is so potent and breeds success, why doesn't every MIS department practice it? The reason is that enthusiasm, like sincerity, is difficult to fabricate. It must be genuine. And because it can easily be dampened, it must also be meticulously cultivated. Several methods can assist in this task.

- **Recognition.** One means of instilling enthusiasm in others is by making a point of recognizing their roles and contributions. Not only is this a practice that needs special emphasis at the operator or programmer levels, but it is surprisingly overlooked at the project leader and manager levels as well.

Public accolades are especially appealing to one's self worth. Group acknowledgement can contribute to a person's sense of belonging and adhesion to a work unit. Either way, it is easy to get excited about feeling valuable and effective.

- **Participation.** Another element that reinforces good feelings is a sense of belonging and confidence about the environment. Participation on a broad front gives this perception to people, even if it simply provides vicarious involvement in activities. MIS usually has many projects under way. Just keeping the farthest reaches of the department apprised of these ventures will help to bolster a sense of participation and instill department members with an awareness of broader accomplishments than what they might envision on their own.

Encourage the role each MIS professional plays in a successful achievement to enhance esprit by relating each task back to an individual. Emphasize the recognition that each person receives for playing a part in a noteworthy endeavor.

- **Sense of perspective.** A litany of achievements is all very well for impressing people but hardly enough to build enthusiasm if no one knows the purpose of these accomplishments. Explain how efforts fit a larger organizational context. This big-picture approach might be stressed by showing MIS services from the standpoint of someone who needs them to do his job.

User testimonials, tours and orientations broaden the vision of those confined

Continued on page 8

Young is managing director of MIS for the Wheeler Group, a division of Pitney Bowes, Inc. in Hartford, Conn.

Q AND A

Ronald G. Ross

Nuts-and-bolts data administration functions will be transformed by business slant

Ronald G. Ross is the founder of consulting firm Ronald G. Ross Associates and the editor of the "Data Base Newsletter," both based in Houston. His consulting practice includes work with entity modeling, logical data base design, strategic data planning and data administration.

A frequent speaker at data processing user conferences, Ross is the author of the books *Data Base Systems: Design, Implementation and Management* and, most recently, *Entity Modeling: Techniques and Application.* Ross spoke with *Computerworld Focus* Senior Editor Stan Kolodziej about the changing landscape of corporate data base administration.

In the past, you've mentioned that corporations will have to restructure their DP operations because of the influence of technologies such as expert systems. Could you elaborate?

First of all, I divide the world into two parts: the data-oriented professional staff, such as data and data base administrators, and those, such as business and systems analysts, who are more concerned with programming and computing support. Recently, our newsletter conducted a survey of U.S. corporations of all sizes and in many industries.

Within the 182 firms that responded, we found there was roughly a ratio of eight programming support staff members to each data administration staff member. What concerns me is that as we move toward some of the higher technologies, starting with relational data base systems, then into computer-aided software engineering [CASE] and, ultimately, into expert systems, U.S. companies are not going to be staffed with enough data administration people to provide the necessary coordination of these technologies.

The entire field of data administration is becoming well established in organizations, but the staffing is not keeping pace with the speed in which these new technologies are being delivered. The result will be bottlenecks in trying to deliver more standardized data base solutions and planned data base architectures in corporations. These new technologies are also not going to achieve user expectations.

What exactly is the problem? Is it because MIS has difficulties grasping the implications of new technologies?

Not necessarily. It's a rare company today that hasn't at least thought about relational data bases and CASE engineering and is moving in that direction.

But to reorganize themselves, to restructure themselves, to develop staff expertise and to develop the procedures to involve that staff in the ongoing development of new data base systems is a very difficult step; it involves human factors, it involves changing the political climate, it involves changing procedures and, ultimately, it involves budgets.

We have a well-established mentality in data processing that's focused on application-by-application development within departmental budgets. To make these new technologies ultimately effective, we need to encourage a more corporate point of view, more corporate patterns of funding and a more corporate-oriented information resources management function under which data administration will fall.

You're talking about overcoming an MIS mind-set.

Absolutely, but it's happening. I think we're seeing a long-standing trend that began way back in the early '70s with the advent of data base management systems. I think the end point of this whole trend is to view data as a corporate resource, as something that's shareable across departments, across the organization, and use that philosophy as a stable platform to build corporatewide systems.

There has been so much talk about hardware platforms and concentrating on hardware in terms of systems architecture design and technique. Instead, I like to talk about the data base concept as being the platform for coordinated systems development across a corporation.

Won't you still need the existing systems infrastructure?

Yes, you need data administration working at a nuts-and-bolts level to ensure procedures are followed, standards are achieved and things are documented.

But you also need a blotter function, an information resources function, a large-scale long-term planning function whose job it is to ensure that the information is exploited as a vital corporate resource.

That's all fine and good, but where do you find people to staff these new areas?

Interestingly enough, as people get more involved in building these new data base architectures, they're finding that the expertise they need to draw on is not so much from the data processing department as it is from other areas of the company, other business divisions.

These people have some insight into the idea that information is something that needs to be designed and coordinated, and these are people who have a real sense of mission about what automation can do beyond the basic application levels.

Another talent pool exists in the traditional data administration staff. These areas are producing some business-astute people, people who have dealt with user requirements, who have looked at corporate objectives and tried to translate those into system architectures.

Where does that leave the data processing departments?

There are also staff-level people in data

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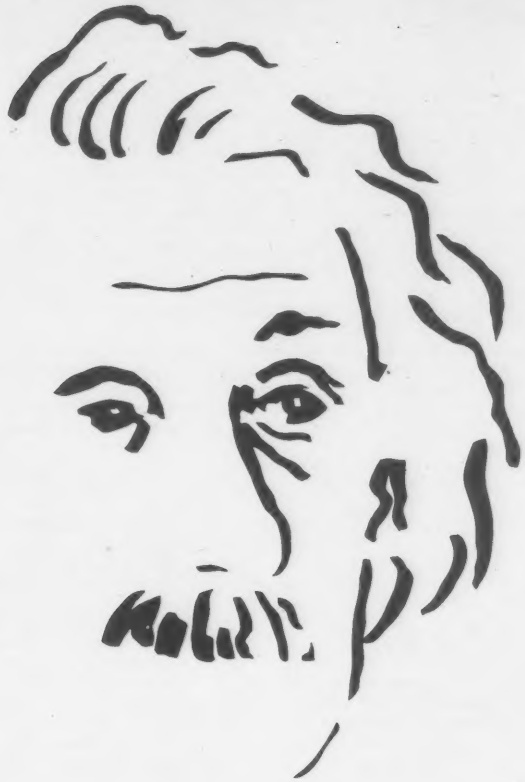

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Manager's corner

Continued from page 6

to the MIS trenches and bring home the real value of MIS's contribution. For the more jaded MIS staff members, demonstrate the hard dollar savings, quantifiable cost avoidance and specific revenue generation that is attributable to MIS's efforts.

• **Sense of opportunity.** A tradition of past contributions can set the stage for positive feelings. On the other hand, there is nothing like future prospects for continued success to whet the appetite for more challenges and to energize continuing activity. Sharing future MIS and organizational plans as well as the opportunities available can serve as real motivators, especially if everyone knows how they can get involved.

Explain how workers can qualify for a desirable project or an up-and-coming area of technology. However, don't forget to define the longer term opportunities available through promotion and how to acquire the necessary skills and experiences.

Finally, to accelerate the growing feeling of self assurance, let everyone know the rules for success. In your organization, what is especially important to do to receive serious rewards — Take risks? Be a maverick? Be a team player? Be an idea person, or, perhaps, an implementor? Make MIS aspirants aware of these unspoken rules. Knowing them can make an enthusiastic professional positively fearless in his efforts to contribute.

These actions, calculated as they are to electrify MIS, all rest on one vital assumption: Enthusiasm and enjoyment come from meaningful professional contributions, and the reverse is also true. If these results fuel one another, then it only remains for MIS management to spur the process by heightening the excitement and fun within a department. Approaching this workplace ideal may be easier than first imagined, because fun for MIS professionals seems to reside in successfully doing their jobs. At least we have not lost *that* attitude.

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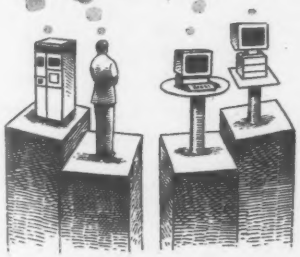

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Q and A

Continued from page 6

processing departments who have always been involved with systems planning, large-scale user requirements and systems integration and who now want to move into something like this information resources management function. So I see a variety of sources from which people can come together and initiate a movement in this direction.

Have you seen companies actually working on such broader data base issues now, or are they still in the concept stage?

Right now, I'd have to say that information resources management is still in its very early stages. There are some similar corporate resource groups being formed, but typically, they are tightly coupled with strategic data and information systems planning.

But I believe this is also the immediate stage before true information resources management is put into place. In our survey, however, we did find that there is a small but growing percentage of data administration people who are reporting outside of data processing altogether. To me, that indicates that their function is being perceived increasingly as a business information systems planning function as opposed to a nuts-and-bolts data processing function.

Do you see a separate organizational unit springing up around information resources management, something like the information centers that followed the appearance of fourth-generation languages?

The company that will prove itself most capable in exploiting this technology will be one that sets up a special organizational unit devoted to ensuring that the data base applications are well chosen, users are well trained, there is coordinated product support and rules and standards are applied. Like information centers, I think we'll see an equivalent body emerging in those companies that prove themselves most capable with expert systems.

Frankly, I don't think that, in the initial stages of expert systems, we are going to see traditional data processing, with its applications-oriented developers, being in the forefront of this movement. I fully anticipate the emergence of something we might call a "knowledge center" that will try and concentrate expert systems skills into a well-coordinated group effort.

Expert systems obviously loom large in your scenario of future corporate processing.

Yes, but there is a caveat. Gerold Cohen, president of Information Builders, Inc., the developers of the Focus fourth-generation language system, recently made the claim that the application backlog will suddenly expand significantly in the next few years as expert systems begin infiltrating the corporate data processing environment. He says this is going to happen because we're suddenly going to realize that there is an immense number of potential applications, or knowledge, being encapsulated and exploited in different ways to make firms more effective. As a result, productivity might actually slow down before it moves ahead again at great speed.

news & analysis

UPDATE

Unix, Xenix wedding bells

It could be a marriage made in heaven or, at least, in California. It's the match of Unix and Microsoft Corp.'s Xenix, with Altos Computer Systems playing the minister. Ever since AT&T attempted to bring all the competing versions of Unix into one standard — Unix System V — developers have tried to merge Unix and Xenix. Neither Microsoft nor AT&T has been overwhelmingly successful in combining the two operating systems, but now small-systems vendor Altos seems to have pulled it off.

A leading Xenix systems vendor, San Jose, Calif.-based Altos has merged the Microsoft operating system with System V. In fact, Altos merged Unix and Xenix so well that Microsoft went to them for advice on how to get the job done. Altos and Microsoft have agreed to share the technology.

This is in keeping with the history of commercial Unix's development. Traditionally, commercial Unix has been the property of small business computer vendors like Altos, and when it has progressed technologically, it has usually done so at the hands of such vendors.

Uniplex's change of fortune tied to Unix's maturity

Isn't it funny how Unix-based office automation software has started slipping into commercial computing? This has happened primarily on the backs of small business and departmental computers.

Texas Instruments, Inc. in Austin, Texas, markets the TI 1000 Microsoft Corp. Xenix- and Unix-based departmental systems. In December, TI announced that it would be remarketing the Uniplex II OA package from Dallas-based Uniplex Integration Systems, Inc. Uniplex II combines word processing, relational data base management, spreadsheets and graphics into a single package.

Actually, what makes Uniplex unique is its age. Uniplex is a child of Redwood International Ltd. in St. Albans, England. Uniplex has been trying, with limited success, to enter the U.S. market since 1985. Now, almost overnight, it is racking up value-added resellers and opening up a U.S. office.

Why the sudden change of fortune now is not clear, but a report from the San Jose, Calif.-based market research firm Dataquest, Inc. suggests that Uniplex's success as a company may be linked directly to Unix's increasing maturity as a market.

Motorola inks OEM deal to aid in departmental push

Marc Software International in Palo Alto, Calif., has announced that it has cut an OEM deal with Motorola, Inc.'s Microcomputer Division in Tempe, Ariz. Under the terms of the agreement, the division will remarket Marc's Wordmarc word processing packages and Linkmarc communications software through its distribution network.

The Motorola division sells mostly to value-added resellers, system integrators and OEMs, and the Marc deal will provide extra impetus to Motorola's efforts to bring its processors to the departmental and small business computer market. However, there is a kicker. Motorola also has a systems division, Motorola Computer Systems, Inc., which is trying to sell into the same market with its own departmental offerings. There could be interesting complications shaping up here.

Netron makes a CASE for IBM mainframe clients

Computer-aided software engineering (CASE) keeps coming to mainframes. Netron, Inc. in Downsview, Ont., has announced an IBM MVS version of its software engineering system, Netron/Cap. Prior to this announcement, Netron/Cap had run on Digital Equipment Corp. VAXs, personal computers and Wang Laboratories, Inc. minis.

With its mainframe debut, Netron/Cap joins a host of CASE and other software engineering tools that have targeted MIS's realm. But the question is whether MIS managers want CASE products per se. It may be that, given the constraints of budgets and time, MIS might prefer to automate code generation completely.

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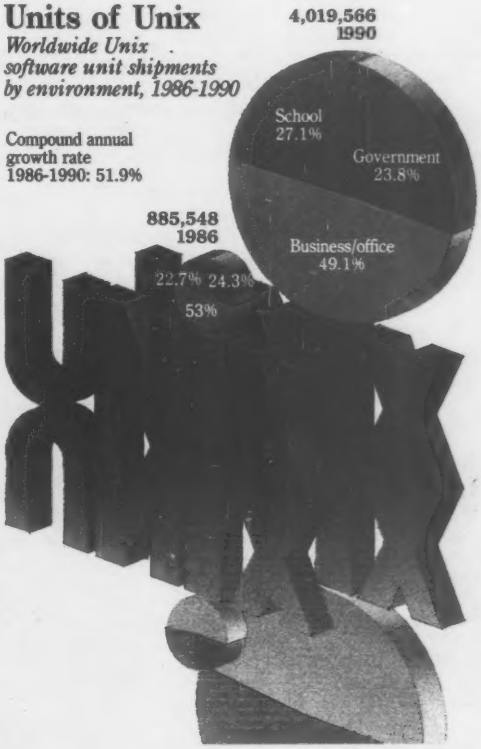
Units of Unix

Worldwide Unix software unit shipments by environment, 1986-1990



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GRAPHIC BY BRUCE SANDERS

PS/2 clone makers take the Micro Channel dare

At times, personal computer hardware vendors must feel like the industry is a game of Russian roulette with IBM's finger on the trigger.

For the past several months, IBM has been pointing a gun at the heads of potential cloners of IBM's high-end Personal System/2 microcomputers, which use the firm's patent-pending Micro Channel bus architecture.

William C. Lowe, president of IBM's Entry Systems Division, has successfully stirred up some trouble in the PC market recently. For one thing, Lowe has made it clear that IBM's attorneys will come down hard on vendors that have too liberally duplicated copyrighted Micro Channel architecture technology. Then, playing the devil's advocate, Lowe also has stated that IBM expects a healthy and legal PS/2 clone market in the near future, ruefully adding that any vendor that waits too long with a PS/2 clone will be "left in the dust."

Clone vendors are understandably wary to be the first to test the Micro Channel-compatible waters. Wyse Technology in San Jose, Calif., for instance, says it is holding back the launch of its Micro Channel-compatible personal computer until the legal waters clear a bit. Though Wyse says it has built its own compatible chip sets, other clone vendors say they will look to outside

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IBM hits a source spot

IBM/Fujitsu code deal touches off outcry from ADAPSO

BY RICK DALRYMPLE
SPECIAL TO CW FOCUS

Crying foul, ADAPSO, the software and services trade organization, claims that a foreign vendor has gained a competitive edge over U.S. vendors at a time when U.S. competitiveness is in peril. ADAPSO's outcry follows the much-reported IBM-Fujitsu Ltd. settlement, under which the Japanese firm was granted access to certain IBM source code.

Calling in the referees, ADAPSO informally discussed its case with the Federal Trade Commission (FTC) and the Department of Justice in the U.S. as well as with the Bureau of Competition of the European Economic Community (EEC). The meetings were held in late December.

IBM's policy of not releasing source code and of marketing bundled software products has long been a point of contention with ADAPSO's membership.

ADAPSO sent its delegation to the government organizations following meetings with ADAPSO members whose firms had individually discussed the source code and bundling issues directly with IBM. A review of the progress made with IBM on these issues at ADAPSO's software products section board of directors meeting in December determined that IBM had not become more conciliatory and recommended that meetings with the government organizations begin immediately.

At the heart of the issue are IBM's Object Code Only policy, formally announced on Feb. 8, 1983, and instances of bundling IBM software products, most recently witnessed in the bundling of the Data Base Manager and Communications Manager into IBM's OS/2 Extended Edition. According to ADAPSO's position paper (updated in September of last year), both practices "inhibit the ability of independent software vendors to develop innovative products, resulting in decreased competition, higher prices, less innovation and fewer product choices."

End users are also troubled by IBM's Object Code Only policy. Object code does not allow users to see the original instructions written by the programmer nor does it provide program logic manuals that explain the structure and internal operation of the software. "Without these tools," laments Sandra Hassenplug, a data processing manager at Towers Perrin, a management consulting company in Philadelphia, "end users who wish to take on the management and maintenance responsibility of changing portions of source code to obtain a specific operating benefit must guess at a solution by using IBM's selected user exits. If we had access to the source code, we might choose a point to insert our own code in a spot between the user exits that IBM has provided."

Fair play?

The meetings with the FTC, Justice Department and EEC are seen by computer industry analysts as a defensive border action to remind IBM that some of its announced policies and actions could be construed as unfair business practices.

"ADAPSO's contact with government groups is but one aspect of the fundamental conflict between independent software vendors and IBM," observes Peter Burris, a software research analyst at International Data Corp., a market research firm in Framingham, Mass.

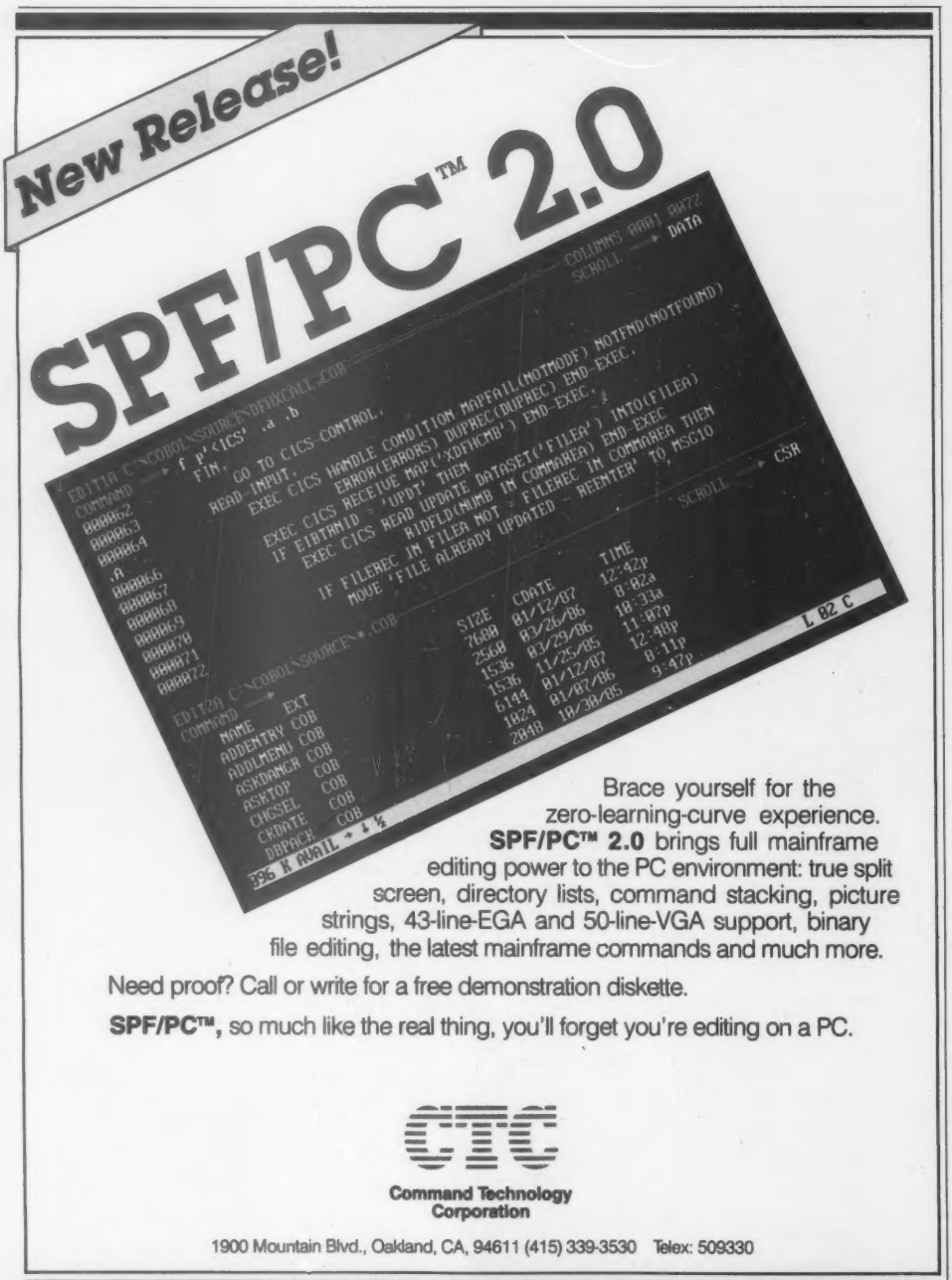
Burris says it is in IBM's financial best interest to increase its software revenue, particularly in the applications area. "Of course," he notes, "ADAPSO's membership would not like to see IBM increase its software revenues by capturing funds that would have gone to independent software vendors.

"By raising the specter of antitrust litigation," Burris adds, "ADAPSO may be able to influence the methods and the rate at which IBM attempts to package its complementary software products to increase software revenues. When threatened, ADAPSO and other organizations representing the interests of third-party vendors can blunt IBM's influence by taking action that slows the pace of change to allow their members to remain vigorous market participants."

Van Weathers, a software analyst at Dataquest, Inc., a San Jose, Calif., market research outfit, agrees that IBM and third-party software vendors must cooperate to succeed.

"The ongoing dilemma is in determining the policies and actions that strike the proper balance of cooperation. IBM needs the products produced by third-party software vendors to sell IBM hardware and software systems to customers that require certain software components only supplied by a third-party vendor. Also, the third-party software vendors need a nonconfrontational relationship with IBM so that they work in conjunction with IBM to fill the software voids IBM chooses not to address," Weathers explains.

Dalrymple is a Boston-based free-lance technology writer.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Better user interfaces hone PC vendors' competitive edge

The personal computer software market has never been known for its ingenuity in user interfaces. But times have changed.

Many PC software vendors have been looking to advances in graphical mainframe-based user interface systems for adaption to PC systems. Probably the most notable success to date has been Apple Computer, Inc.'s Macintosh graphics interface, an innovative system that has been turning the PC industry on its ear the past few years. The Macintosh is being chased by IBM, whose Presentation Manager graphical interface system for the OS/2 operating system is scheduled for a mid-1988 appearance.

IBM has been criticized by users and software vendors for waiting so long to bring something like the Presentation Manager to market. Some analysts say the delay of a good user interface from IBM has hurt its PC sales and enabled Apple to increase its business market share.

However, IBM is not making the same mistake with its ambitious Systems Application Architecture (SAA), a plan aimed at providing standard user interfaces across IBM's Personal Computer and mid-range systems lines. To those who have peeked into the SAA development cycle, the SAA user interface apparently resembles the Mac model closely.

Lessons learned

This lesson has not been lost on other vendors. Microsoft Corp.'s Windows user interface has received more user and third-party support than Microsoft expected. Lotus Development Corp., the Cambridge, Mass., maker of the 1-2-3 spreadsheet, has seen its HAL 1-2-3 add-in program become a commercial success. Among other benefits, HAL is above all a translation tool that converts English phrases into a series of 1-2-3 commands.

Lotus will also depart from its nongraphics 1-2-3 design when it comes out later in 1988 with 1-2-3 G, a graphical version of the spreadsheet based on IBM's Presentation Manager.

Others are jumping in. Ashton-Tate Corp. is streamlining the interface to its Dbase PC data base management system, integrating the interface with IBM's Presentation Manager.

According to Borland International, Inc., its purchase of Ansa Software last year will result in better user interfaces with its own products, culling the experience Ansa has gained in using artificial intelligence at the PC level. Part of that collaboration, Borland says, has already been incorporated in its recently introduced Quattro PC spreadsheet package.

Improving PC software user interfaces has not only become an exercise in software engineering progress, it has also virtually become a marketing necessity to spur sales and remain competitive.

"User interfaces will become one of the major issues in software in the 1990s," claims Linda O'Keefe, a vice-president at Dataquest, Inc., a research firm in San Jose, Calif. "Companies that can supply innovative interfaces will be perceived as supplying the means to break user productivity bottlenecks."

One such company is Expert Vision Associates. The Cupertino, Calif., firm has introduced a PC graphical data base system, called EVA, that has its origin in computer-aided design and engineering environments using larger mini and mainframe hardware platforms.

Written in both Microsoft C and SAS Institute, Inc.'s Lattice C, EVA's developers claim that the product will do for user PC data base interfaces what Apple did for user PC interfaces in general.

More advances in graphical PC interfaces are necessary, according to George Morrow, chief scientist at DSC Nestar Systems, Inc. in Mountain View, Calif.

"Programmers are the worst people in the world to work on user interfaces," Morrow says. "They have trouble getting into the rhythm of how average users work with data. I see a good sign in the increasingly greater numbers of nontechies who are working in the user interface area. In my mind, computer literacy is the greatest stumbling block to making computers more relevant to people. Pictures are interfaces to the meaning of words, and graphical interfaces are going to open up computer literacy and, with it, sales."

Not all user interface progress is graphically based. Lotus's Agenda and Dayflo Tracker from Dayflo Software Corp. in Irvine, Calif., are using relational, free-form technology to ease information retrieval for PC data base users.

"I think users have been waiting for something like free-form retrieval for some time," says Robert Gilchrist, Dayflo's chief executive officer. "It fills a gap with the way users relate to data." — SK

News section written by *Computerworld Focus* staff members Stan Kozodziej and Michael Tucker.

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Circle Reader Service Number 6

Amdahl axes Aspen system

Aspen has been axed. Unix may be enriched.

Until 1987, Sunnyvale, Calif.-based Amdahl Corp. was known for three things: It was a relatively successful plug-compatible manufacturer (PCM) at a time when PCMs were not generally noted for success; it was the only U.S. mainframe maker with its own version of Unix, the UTS product; and, until recently, it was working on a mainframe operating system, Aspen, reported to be the first real challenge to IBM's VM and MVS.

Today, Amdahl is less one good reason to be known. The company announced that it has dropped the Aspen effort. Whatever technology in Aspen that had been produced will be grafted onto UTS.

Why Amdahl decided to chop Aspen is not clear. It may be that Aspen simply was not developing quickly enough. Or, perhaps, the company felt that its real market was in Unix-based systems. "The Unix Perspective" newsletter put out by Framingham, Mass.-based market research firm International Data Corp. recently pointed out that Amdahl is now the leading vendor in the low-priced mainframe market in which Unix is frequently the operating system of choice.

It has also been said that Amdahl may have given up on Aspen after the recent pact between Fujitsu Ltd. and IBM, whereby Fujitsu received access to IBM source code. Amdahl may have wanted out of Fujitsu's way should that firm decide to offer a PCM operating system.

Regardless of the motivation, the consequences may be great for Unix. For the first time, it has a serious champion on the mainframe side of the fence. Before, observers speculated that Amdahl might drop UTS for a more proprietary approach. Now, that is not an option. — MT

IBM dare

Continued from page 9

suppliers, such as Western Digital Corp. in Irvine, Calif., and Phoenix Technologies Ltd. in Norwood, Mass., to deliver the necessary components for Micro Channel look-alikes.

It is a waiting game that could go on for some time. "A patent application doesn't preclude you from distributing your product in the market," explains Joseph P. Zammit, a partner in the New York-based law firm of Reavis & McGrath. "IBM could have applied for a Micro Channel patent a few years ago or a few months before the PS/2s were introduced. It's not unusual for a whole patent application process to take years to complete."

Nancy McSharry, a senior analyst of personal computers at market research firm International Data Corp. (IDC) in Framingham, Mass., says that IBM, with the Micro Channel, is redressing the events surrounding the introduction of its original Personal Computer.

"When IBM came out with the PC in 1981, they had little idea it would be as popular as it turned out," McSharry says. "It wasn't prepared legally, and by the time it had successfully sued Eagle Computer, Inc. and others for copyright infringement, it had lost a lot of business. Now it is prepared."

McSharry agrees that clone vendors should be wary of coming out with the first commercial PS/2 Micro Channel clone. For one thing, IBM lawyers are fresh from dealing with a trademark infringement case involving AST Research, Inc. and the use of "/2" in the name of its PS/2 add-in boards, Advantage/2 and Rampage/2. The case was settled out of court with AST removing the "/2."

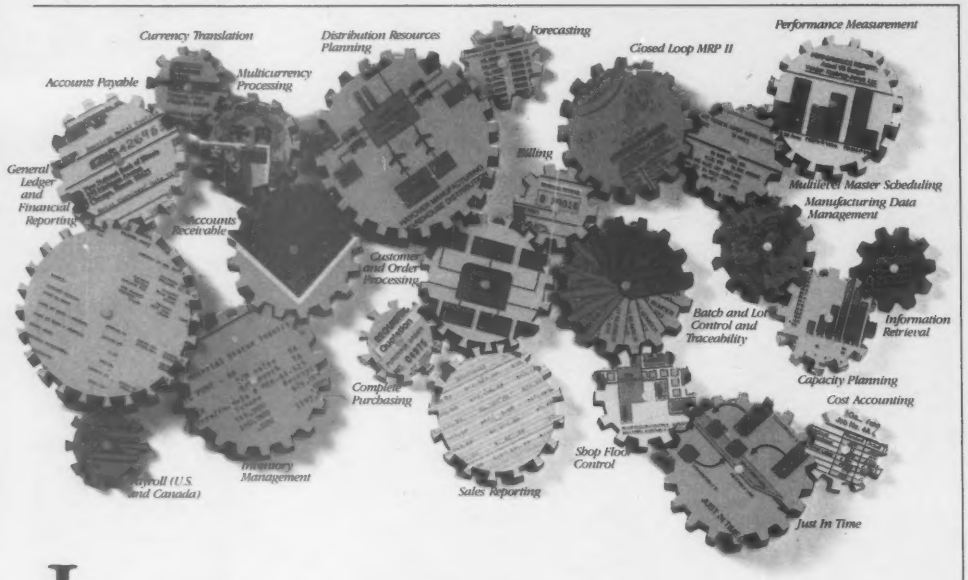
"In a way," McSharry says, "it isn't odd that Lowe seems to be promoting the PS/2 clone business. With all the vendors who are bound to duplicate its machines, it could only bolster the perception that the PS/2 and the Micro Channel are true standards in the PC industry. IBM will lose business to the clones, but it might more than make up for it with the business this standards perception creates."

IBM's Lowe

For now, the legal ramifications of the PS/2 clone market seem to concern vendors and industry analysts a lot more than end users. McSharry says a recent IDC survey of users indicated that most were unconcerned about the PS/2 clone market and many also confessed to being in the dark about the Micro Channel architecture.

For example, although Bob Ebersole, a PC consultant at Westinghouse Electric Corp. in Hunt Valley, Md., says PS/2s will be Westinghouse's primary machine purchase in 1988, he is "unsure that the Micro Channel provides adequate progress over the old PC buses."

In the meantime, clone vendors wait to see who will be daring enough to break out first with a Micro Channel clone and possibly become the first name on the IBM legal counsel's blacklist. "You never really know with IBM," McSharry says. "It's like studying the Kremlin. You know what they say, but you don't know what they mean." — SK



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Circle Reader Service Number 7

Washington, D.C., March 21–23, 1988 Chicago, May 16–18, 1988

National Database & 4th/5th Generation Language Symposium

A Digital Consulting, Inc. Conference

Topics:

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Relational DBMS
Distributed DBMS
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The 5th Generation of Software
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Speakers

Dr. George Schussel
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A Two-Day Relational DBMS Seminar

See page 7 for details.

Feature Article: Pages 4–5

DAY 1 FORMAT

9:00 a.m. — *Room 1*

INTRODUCTION

George Schussel & James Davey

4th Generation Technologies
The new MIS department • Prototyping • Relational DBMS & 4GLs • SQL

1990—The 5th Generation of Application Development
CASE • Natural language • SAA • Electronic data interchange • Chief Information Officer

Relational DBMS
Structure • Manipulation • Integrity • SELECT, PROJECT, JOIN • Advantages of the Relational approach • Problems with the Relational approach • An analysis of the performance issue

SQL—The New Standard
Examples • Problems with SQL • Portability of SQL

11:00 a.m.

Room 1

MANAGEMENT SESSION

George Schussel

Database & 4GLs

Distributed DBMS
- Selection rules
- Management issues
- Mini vs. micro DBMS

4GLs
- Requirements
- Benefits of 4GLs
- Different types of 4GLs
- Ease vs. performance
- Management issues

Codd's 12 Rules
- Explanation
- Importance

Prototyping
- Life cycle dangers
- How to use
- Advantages of prototyping
- Prototyping requirements
- When to use a prototype

Room 2

TECHNICAL SESSION

James Davey

Post-Relational Data Models

Entity-Relationship
- Classification of entities and relationships
- Attributes and values
- Keys
- Weak entities
- Entity-relationship diagrams

RM/T Model
- Classification of entities
- Subtypes and supertypes
- Surrogate keys
- Integrity rules

Universal Relation Assumption
- Definitions
- Database design
- User Interface

12:00 p.m. — **Lunch**

1:00 p.m.

5th Generation Application Development

CASE
- Objectives
- Integrating technologies
- Diagramming
- Code generation
- Methodology
- Management concerns
- Future directions

Repository
- Active & integrated
- Functions
- User access
- Communications
- Programming interfaces

The Software Market

Selection of DBMS & 4GLs

Logical Database Design

Normalization
- 1st normal form
- 2nd normal form
- 3rd normal form

Canonical Synthesis

Field Level Dependency

Conceptual Data Modeling

Diagramming Types
- Data structure diagrams
- Entity-relationship diagrams
- Entity-relationship diagrams used in information engineering

The Software Market

Selection of DBMS & 4GLs

2:45 p.m.

Mainframe Products

IBM's DBMS & 4GLs
- The installed base
- Intentions to buy
- Strategies for IMS users

SQL/DS & DB2
- How functional?
- How much performance?
- DB2 futures

Design Aids, CASE Tools

CSP, AS, QMF
- CSP experiences
- Management implications

Mainframe DBMS & 4GLs
- ADR, Cullinet, CCA, Software AG, IBI, RTI, Oracle, Teradata & more

Mainframe End User Software
- IBM, Cullinet, IBI, OSI, MUST, more

Minicomputer Products

DEC's DBMS & 4GLs
- COBOL Generator
- RALLY
- Rdb
- DBMS
- RMS

Minicomputer DBMS & 4GLs
- ORACLE, INGRES, IDMS/R & SQL, POWERHOUSE, CORVISION, ULTIMATE, more

4:15 p.m. — *Room 1*

DATA MANAGEMENT FUTURES/HOT TOPICS

Question & Answer Session — George Schussel & James Davey

DBMS • SQL • Distributed DB • Interfaces • CASE • Repository • Expert Systems • Industry

5:00 p.m. — **Hospitality Suites/Product Demos**

Day One Faculty

DR. GEORGE SCHUSSEL
SYMPOSIUM CHAIRMAN

Dr. George Schussel, President of Digital Consulting, Inc., is one of the world's leading lecturers on DBMS/4GLs and 5th generation application development. He is a noted futurist who accurately predicts key software trends years before they occur. His influential role in the industry prompted ICP Interface Magazine to say "... when changes occur (in the software industry), it's a safe bet George Schussel will be there to help the business community adapt."

Dr. Schussel received his doctoral degree from Harvard Business School and is a Fellow of the AAAS.

JAMES H. DAVEY

Jim Davey is Senior Consultant with Digital Consulting, Inc., specializing in database management systems, logical database design, 4th generation language and structured analysis and design. He has over twenty years of experience in design and implementation of database systems.

Before joining DCI, Mr. Davey was Senior Database Consultant with Eastern Technical Associates, Manager of Product Support and Assessment for Prime Computer and Database and Software Support Specialist for Honeywell and General Electric.

The Unique DCI Symposium

The National Database and 4th/5th Generation Language Symposium presents a unique integration of educational seminars and product discussions. The Symposium is NOT a tradeshow. It is 3 days of education and information which will better equip you, the DP professional, to make key decisions about your company's strategic future.

Day One of the Symposium features a full day of Management and Technical education led by Dr. George Schussel and James Davey. The unique format of this education is outlined on page 2. The issues discussed as well as product overviews and critiques will prepare you for Days Two and Three.

The evenings at the Symposium are an important part of the three day conference. They feature Hospitality Suites hosted by participating vendors, many of which offer live product demonstrations.

On Days 2–3 of the Symposium you will have the opportunity to attend presentations covering the key products in the industry. Three sessions run concurrently throughout the two days and are led by representatives from each vendor company. In a classroom style environment, the representatives explain what their product is, what it does and does not do. You are free to move between presentations as you wish; however, many companies send more than one employee to the Symposium in order to get the maximum benefit from the presentations. Guest lecturers will cover added areas of interest and DCI consultants will be available to answer your specific questions. In three days at the DB 4th/5th GL Symposium, you will accomplish product research which could have taken months.

As a unique feature of the DB 4/5GL Symposium you are also encouraged to attend our Free Two-day Relational DBMS Seminar. Led by Jeff Tash, this seminar will focus on practical applications development as well as theory (see page 7).

If you are interested in planning the right direction for your company and need to choose the proper software products, the Symposium is an event you don't want to miss.

Special Presentations

IBM'S Software Products

DB2, SQL/DS, QMF, IMS, CSP, AS

A critique of IBM software products will be part of the first day's presentation. Our consultants are continually surveying users of IBM's software products. Feedback from current users will be provided for attendees.

TEXT INFORMATION MANAGEMENT

An area of importance to many companies is TEXT INFORMATION MANAGEMENT SYSTEMS (TIMS). These systems can provide many services:

1) Text search and storage and adhoc retrieval for many documents
2) Support for both structured and free flowing documents
3) Processing of "noise" words
4) Operate in both on-line and batch fashion
5) Search with Boolean logic, proximity and wild cards
6) Thesaurus capabilities
7) Corporate records management
8) Automatic data loading
9) Video image capability

Excellent applications of TIMS include: litigation support; newspaper archives; and financial information.
Sessions at DB + 4/5GL will discuss TIMS. Traditional DBMS such as CODASYL or Relational, don't have the ability to provide these kinds of services. TIMS are especially important in office applications.
Examples of products providing these services include: Computertime Network Corp. — HR pkg., Payroll, Computer Corporation of America — TEXT/204, Information Dimensions — BASIS, Henco — INFO DB+, and G.E —GESCAN

APPLICATION DEVELOPMENT IN THE 5

Now that 4th generation application development tools are well accepted, the question arises "Where are we going to and what will be the characteristics of the 5th generation of application development"? Future issues are a major discussion item at the DB + 4/5GL Symposium. A summary of some discussion points from recent symposia are presented below.

RELATIONAL DBMS

Occasionally, one hears comments about "post-relational" DBMS. Adoption of such a technology seems unlikely in the near to midterm future. The advantage of the relational model's mathematical underpinings and the promised wide adoption of the ANSI standard SQL make it highly unlikely that some other logical view of data for commercial processing will be widely adopted in the next ten years.

It is clear, however, that one weakness of relational modeling lies in its modest ability to capture meaning in the same way that network-oriented views of data can. It's most likely that various "semantic modeling" extensions to the relational model will be proposed and one or more may achieve widespread adoption. The ability to capture more meaning in your database structure can mean significant additional savings at the programming level and superior control for data administration.

A number of new relational DBMSs from companies like Sybase, Tandem and Interbase are now targeting the high performance relational DBMS market. These vendors claim distributed capabilities and significantly increased transaction processing potential. Meanwhile, established relational DBMSs such as ORACLE, INGRES, and INFORMIX continue to improve their transaction processing potential by an average of 30%/year. These software improvements combined with rapidly improving MIPS/$ hardware mean that while INGRES 2.0 on a VAX 11/780 was not feasible for your application, INGRES 5.0 on the VAX 8550 will have an 800% cost per transaction improvement and may therefore be very feasible.

Our conclusion is that while network-oriented data views are likely to remain superior for difficult transaction processing applications for the next few years, an ever increasing majority of transaction processing applications will be amenable to solution by relational DBMSs.

If you must bet on the next generation of DBMS, try "Object Oriented DBMS". Research in this area is focusing on how DBMS engines can directly support the object oriented programming paradigms that underlie expert systems technology. Practical products from such research, however, lie several years in the future.

DATABASE MACHINES

One important approach to transaction processing in tough relational processing applications is database machines. Teradata and Britton Lee, offer some significant cost improvements in high volume relational transaction processing. Teradata, for example, has some benchmarks showing a 10–1 price/performance improvement over the use of a straight software only DB2/SQL implementation.

A relational DBMS machine from IBM is not likely. As personal computer workstations continue their takeover of many functions formerly assigned to the mainframe, the host computer's logical future role is as custodian of the corporate database. Architecturally, then, one can look at mainframes as evolving into data base machines and network servers. The concept of a database machine is to offload the database accessing and control from the mainframe to a parallel processing, micro computer architecture. If the job of handling the user interface is offloaded onto personal computers while the job of handling database access is offloaded onto back end machines, the question arises, what is left for the mainframe? The answer of course is nothing, and that is the principal reason why IBM won't do anything to encourage the growth of database machines.

PRODUCT PRESENT

THE FOLLOWING PRODU

Vendor	DB & 4GL Packages
3CI Inc.	InFoCen
Applied Data Research, Inc.	DATACOM
	IDEAL
Cognos, Inc.	POWERHOUSE
Computer Associates	
International, Inc.	CA-UNIVERSE
Computer Corporation of America	MODEL 204
	IMAGINE
	ACCOLADE
CompuServe Data Technologies	SYSTEM 1032
Computertime Network Corp.	HR pkg
	Payroll
Cullinet Software, Inc.	IDMS/R, ADS/O
Data Access Corp.	DATAFLEX
Digital Equipment Corp.	VIA, Rdb, 4GLs
Execucom Systems Corp.	IFPS
Gateway Systems Corp.	SYNERGIST
G E	GESCAN
Genex	INTELLISYS
IBM Corp.	DB2, CSP, AS
Information Builders, Inc.	FOCUS
Information Dimensions, Inc.	BASIS
ISN Products Corp.	SPIRES
McCormack & Dodge	MILLENNIUM
Micro Data Base Systems, Inc.	MDBS III
Micro DecisionWare Inc.	PC/SQL-link
MultiSoft, Inc.	SUPER-LINK
MUST Software International	NOMAD Family of Products

SQL

There has never before been a standard data access language. SQL is going to change that. SQL was developed by IBM in the late 1970s and IBM has based its two strategic DBMS products, DB2 and SQL/DS, on SQL. The most successful independent DBMS software vendor, ORACLE, is based on SQL. The American National Standards Institute and the International Standards Organization have adopted SQL as the standard language for relational DBMS access. The US government will require SQL in future procurements.

With all of these things going for it, it's clear that by the 1990s SQL will be the standard language for data manipulation, definition, and control. This will offer important portability benefits for both human skills and software.

5TH GENERATION by GEORGE SCHUSSEL

NTATIONS — DAYS 2 & 3

DUCTS WILL BE PRESENTED:

Vendor	DB & 4GL Packages
Novell, Inc.	Btrieve, XQL
Officesmiths, Inc.	THE OFFICESMITH
On-Line Software International, Inc.	RAMIS Information System RAMIS/PC Workstation UFO Productivity System INTELAGEN
Oracle Corporation	ORACLE
Pansophic Canada	TELON
Phoenix Software	SIGNET
Relational Technology	INGRES
Rhodnius	EMPRESS RDBMS
Seed Software	SEED
Software AG of Canada	ADABAS NATURAL
Software AG of N.A.	ADABAS NATURAL
Tandem Computers	NONSTOP SQL
Technology Information Products Corp.	INFO MODELING DATA MODELING
Teradata Corp.	DBC/1012
The Ultimate Corp.	ULTIMATE
Unilog, Inc.	GEN/1
Unisys Corp.	MAPPER LINC II
XA Systems Corp.	DATA XPERT
Zanthe Information, Inc.	ZIM

SQL is not suitable as an end-user language. For any but trivial uses SQL should be handled by programmers, not end-users. Proficiency with SQL is best achieved when the user has some academic background in set theory and propositional logic.

Therefore, we expect to see SQL "generators" becoming important. When SQL becomes the generated rather than the written language, users can keep the advantage of familiar interfaces such as spreadsheets, yet at the same time, generate applications that are portable from one database engine to another.

Viewed a few years from now, SQL's major importance will be as the standard language for data access communication from one software system to another. SQL ultimately is more important as a software rather than as a human interface.

DISTRIBUTED PROCESSING

In the 1990s leading edge organizations will be using three-tiered computing. The idea behind three-tiered computing is to support personal workstations at the individual or group level, mini-computer data processing at the departmental level, and mainframe hardware to handle common data base applications that run across several departments or companies. There are two software technologies that will allow this. The first is distributed database technology, while the second is cooperative processing.

The idea behind distributed databases is to have a single logical database implemented over diverse machines. Early incarnations of distributed database software are now available from vendors such as Relational Technology, Oracle and ADR.

Cooperative processing systems such as PC/SQL-link from Micro DecisionWare of Boulder, Colorado or SYNERGIST of Gateway Systems of Lansing, Michigan represent an alternative technology approach to building distributed applications. The logic behind these sytems is to offer 4GL application development on a workstation coupled with an active Data Dictionary on a central minicomputer or mainframe. The Dictionary power is such that reusable functions can be built into the system and the logic of its architecture supports both development and execution on a distributed basis.

The 5th generation of application development will be heavily characterized by both a development and execution environment that is largely distributed. Distributed DBMS and cooperative processing systems will lead in providing the support necessary for the building of these applications.

STANDARD ENVIRONMENTS

The early 1990s will give rise to the recognition of six broadly implemented operating system environments, all of which are widely used and considered "standards":

Vendor & Operating System	1986 Market Share	1991 Market Share
DEC's VMS	5%	6%
IBM's MVS and VM/CMS	26%	24%
AT&T's UNIX	6%	22%
Microsoft's MS DOS and OS/2	18%	23%

The vendors of successful productivity tools will provide support in all of these operating environments.

CASE AND 4TH GENERATION TECHNOLOGY

By the mid 1990s the building of applications by business analysts using integrated CASE/DBMS/4GL technology and without programmers will be normal and expected. Successful use of CASE is predicated on the existence of business function and data models. As the power of CASE technology becomes available the demand for people who can implement models will escalate. More than any other single technology the dependency on CASE techniques will define the 5th generation.

THE ADVENT OF EXPERT SYSTEMS

At the current time very little AI technology has permeated the world of commercial systems. Expert systems offer the greatest promise of changing that.

By the 1990s rule based programming will be available to normal commercial programmers. Like DBMS, transaction processing monitors, and report writers then, expert systems will become another tool in the application builder's portfolio.

GUEST SPEAKERS

DR. GEORGE SCHUSSEL

Dr. George Schussel is one of the world's foremost experts in data base management technologies. He is President and founder of Digital Consulting, Inc., a prominent high technology education and management consulting firm. Dr. Schussel is a noted futurist who accurately predicts software trends years before they occur.

Hardware and Software Futures and the 5th Generation of Computer Technology

1. **Computer Architectures: The New Battleground**
   a. Three tiered architecture
   b. IBM vs. DEC vs. UNIX
   c. IBM's role for PS/2
2. **Enhanced PCs for the Future**
   a. The PC in 1991
   b. The PC in 2000
3. **The Importance of Generic Computers Based upon UNIX, MS/DOS and OS/2**
4. **Object Oriented Languages: The New Programming Paradigm**
5. **Expert Systems**
   a. Requirements for Success
   b. Case Histories
6. **Problems with Natural Languages**

LARRY ELLISON

Larry Ellison, President and founder, has been the President and a Director of Oracle Corp., since its organization in 1977. Before founding the company, Ellison held key development posts at Amdahl and Ampex Advanced Research. He holds advanced degrees in physics from the University of Illinois and the University of Chicago.

The Commoditization of Software Technology

1. **Costs of Hardware vs. Software**
2. **Coming Hardware and Software Standards**
3. **The Expansion of Software Lifetimes**
4. **The Importance of Software Portability**
5. **Software Standards—A Must**

NORRIS VAN DEN BERG

Norris van den Berg has had an intensive career with IBM in software development and management, concentrating on both large complex systems and end-user products for business professional users.

He is currently the manager of Data Systems Architecture and Strategy. In this position he carries responsibility across all of IBM's operating units for not only architecture and strategic direction, but market planning and business goals for IBM data base products.

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Jeff Tash is President and Founder of Database Decisions, Inc., an education and consulting company that specializes in database technology and decision support systems. Previously employed by DEC, IBM, CDC, Arthur Young and most recently affiliated with Codd and Date Consulting Group, Jeff has extensive experience in relational database management, fourth generation languages and artificial intelligence. Jeff has assisted a wide range of Fortune 1000 firms understand the impact of relational technology in their organizations and develop ways to evaluate and utilize relational products to gain a competitive advantage. His knowledge of the computer industry coupled with his extensive professioinal experience bridges the gap between theory and practice. He provides practical tips and techniques on how to integrate and deploy the new information technology.

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By Rich Tennant

Unisoft, Motorola champion proposed Unix binary standard

Unisoft Corp. and Motorola, Inc. are doing the binary Unix standards two-step.

The companies have sponsored several meetings of hardware and software vendors during the last year to propose a Unix binary standard format for computers. The intended standard is based on Motorola processors running Unix System V and Posix, a proposed vendor-independent, multiuser standard interface.

The standard has met with expressions of support from many players in the Unix field. "I've actually been quite surprised by the degree of enthusiasm everyone's displayed," says Robin Schlee, Unisoft's chief operating officer. "Several of Motorola's leading customers stated, in public, that they supported the standard."

Until recently, a binary standard for Unix was almost a contradiction in terms. The traditional bane of Unix's existence has been its own diversity. The operating system has been handicapped by the fact that it is divided not only into different, compatible variants but also into different binary formats in individual formats. The same application might not run on machines from different vendors — even though the machines might use the same version of Unix and might be based on the same processor — because the vendors might have the operating system address each processor in radically different ways.

This situation is, of course, in contrast to an operating system like Microsoft Corp.'s MS-DOS, in which two machines based on the Intel Corp. 80286 microprocessor will likely deal with an application in much the same way. There are several reasons for this unity, not the least of which is that IBM Personal Computer compatibility has long been the driving force of the MS-DOS world. As a result, vendors have a ready-made standard.

Unix, by contrast, was never dominated by any one hardware vendor, even though AT&T did manage to set the system's general direction.

However, there have recently been several suggestions that a Unix binary standard might be possible, at least within products that use the same processor. The first Unix binary standard was, in fact, created the way the MS-DOS standard came into being — via Intel's domination of the PC market.

In late 1985, developers at the desktop level proposed that the Intel 80386 might prove the foundation for a new binary standard. At that time, Charles Hickey, then president of Scotts Valley, Calif.-based software porting house Microport Systems, Inc., argued that 386 machines would lead to a new age in computing in which Unix-based software would be as easily portable as MS-DOS applications. As yet, that prediction doesn't seem to have occurred. But then, the 386 installed base remains small.

Now, Unisoft and Motorola are planning a similar binary standard for machines based on Motorola 32-bit chips. Some analysts say this effort may have an even greater impact than the 386 standard. Motorola processors are in most of the machines currently running Unix — from scientific workstations to the Apple Computer, Inc. Macintosh. — MT

Update

Continued from page 9

Mainframe developers get CASE ability on remote microcomputers

Assuming MIS managers really want to be CASE workers, they can take their pick of computer-aided software engineering (CASE) products. In fact, Cambridge, Mass.-based Index Technology Corp. and Micro Focus, Inc. in Palo Alto, Calif., have just introduced software that links Index's Excelerator CASE product with Micro Focus's Cobol Workbench.

The result is a system that lets you do remote development on a personal computer or other micro for IBM mainframes. The Index/Micro Focus joint venture unites similar efforts to bring remote development capability to MIS. Actually, the problems that face such firms are more social than technological. While the scientific and engineering community has been doing remote development for decades, mainframers have so far resisted the technology.

Government study may liberate neural networks from laboratories

Neural networks are computers that attempt to reproduce in hardware or software some characteristics of the human brain. These networks have a number of interesting properties; they can, for instance, learn and recognize some patterns. They are also very much in the laboratory, and, unless some bugs can get worked out, they may be there forever.

However, Edward Rosenfeld, a New York-based market analyst who produces "Intelligence," a newsletter devoted to neural networks, notes that the federal government may give neurals a big push in the direction of practical applications. He says the U.S. Defense Advanced Research Projects Agency (DARPA) has launched a major study of neural networks and neurocomputing technology.

The DARPA research work is scheduled to be centered at MIT Lincoln Laboratories, located in Lexington, Mass.

There's no place like home for the business computer

Remember the home computer market? That was the one that crashed and burned a few years back because nobody could figure out what to do with home computers. Well, there is now a new twist on that old wrinkle, and this one might actually have money in it.

Market research firm Venture Development Corp. in Natick, Mass., has noted that increasing numbers of professionals are running businesses from their homes. In fact, the company says, 18 million people will be combining their personal and professional addresses by 1992.

That being the case, Venture sees a lot of computers, or rather, business systems, adapted for a home market. Now the question is, can we keep the kids from playing Pac-Man on the multiuser, multitasking, reduced instruction set computing-based home machine?

Consulting firms offer business help to the budding entrepreneur

There is a new beast on the block that high-tech businesses may want to note. Several established consulting firms are now offering special high-tech practices that essentially give the would-be entrepreneur one-stop shopping.

For instance, Big Eight accounting firm Peat, Marwick, Main & Co. has recently announced its High Technology Practice, located in Palo Alto, Calif. Peat-Marwick's practice is meant to be the kind of place where you give them the idea, and they give you a business.

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Of course, they will also charge the appropriate fees. As always, there is no such thing as a free lunch. There are, however, several relatively inexpensive brunches. — MT

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Closer, and closer still

386-based servers aim at full power of Intel's chip

BY AVERY JENKINS

Will full-fledged 386 power never arrive? Hailed as a revolutionary step above its predecessor, the "brain-damaged" 80286 (as one programmer describes it), the Intel Corp. 80386 has nearly a year's wait for the software that will really make it hum. But MIS is not sitting still waiting for a complete 32-bit powerhouse. It is looking for interim solutions in what the industry is currently offering, with an eye to what the future holds.

And vendors have responded. Certain stand-alone 386 machines are increasingly being converted into hosts for multiuser systems supporting as many as 32 terminals. Some organizations are turning to existing operating systems that take advantage of some of the chip's power; however, with the exception of Unix, these systems do not enjoy the widespread support of OS/2, which is backed by industry leaders Microsoft Corp. and IBM.

But perhaps most advantageous for MIS, several local-area network companies have in recent months announced or shipped file servers based on the powerful chip. These firms have also modified their network operating systems to take better advantage of the 386, even though some of these networks are still encumbered by the restrictions of Microsoft's MS-DOS, an operating system designed for stand-alone computing.

All the existing and as-yet-unrealized capabilities of 386-based servers begin with the additional power that the 80386 microprocessor contains over the 80286. The 80286 has been hampered, according to systems developers, by poor memory management, limited direct memory addressing and poor task management.

The most important difference between the 80386 and its 286 predecessor is the 386's capacity for full 32-bit memory addressing, compared with the earlier chip's 16-bit limit. This feature both increases the speed with which data can be transferred within the computer and the amount of memory that the chip can directly address.

While the 80286 had a segmented memory management scheme, the 80386's on-chip memory management can address much larger segments of memory directly.

In addition to permitting faster processing, this facility makes it easier for programmers working directly with the 80386 to develop software for the microprocessor.

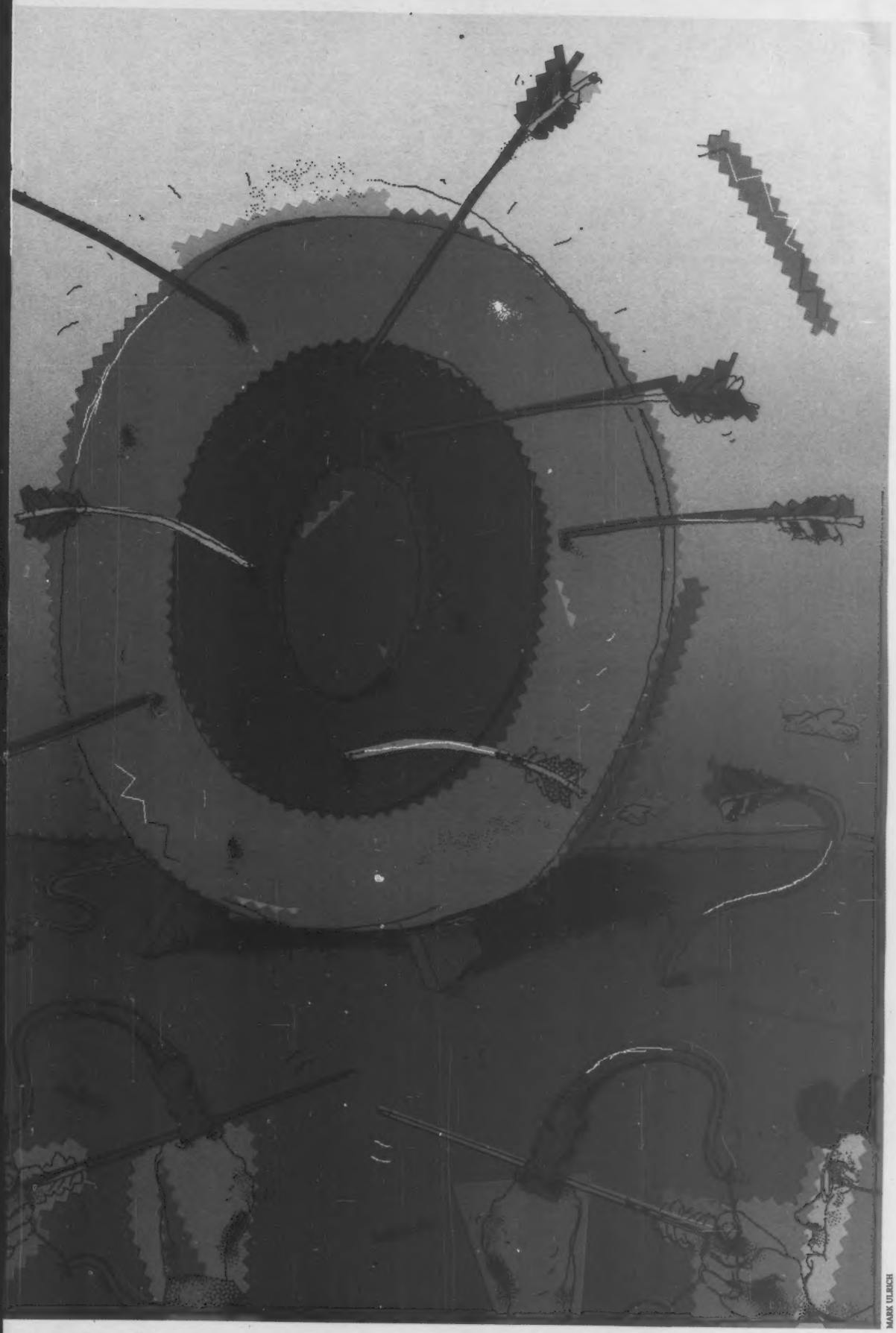
In spite of the limitations imposed by existing designs, 80386 file servers also enjoy the advantage of a higher clock speed than was possible with the 80286. The 80386 operates at speeds of up to 20 MHz, and this increase alone can speed up the response time of a network.

The 80386 also has task switching built into the hardware, a function that the 80286 was only capable of if supported by software. Hardware-controlled task switching is much faster, according to John Fitzpatrick, Intel's 80386 product line manager. Fitzpatrick adds that the 386 can switch among 64,000 tasks.

Task switching is especially important in a file server, according to Bruce Lynch, president of The Programmer's Shop in Hingham, Mass., because file servers must field many requests at a time and must control both file management and network management simultaneously. With the 386's task switching, you can do both at once, Lynch explains.

Lynch adds that to take full advantage of the speed of the 80386, hardware designers must incorporate 32-bit buses throughout their architectures. Although using 16-bit buses would make the machine

Jenkins is a Boston-based free-lance writer.



MARK ULRICH

more compatible with the existing base of add-in cards, this strategy severely limits the overall speed of the machine.

In addition to being faster, the file servers recently announced by the major networking vendors all incorporate 32-bit processing to some extent.

For example, 3Com Corp.'s 3+ server Model 3S/400, released in late October, includes four IBM Personal Computer AT-compatible slots for adding additional communications devices. And while the 3S/400 also includes the ability to add 32-bit memory boards for a total of 14M bytes of system memory, both the Ethernet bus and the small computer systems interface disk I/O remain 16 bit.

Fast memory addressing is not the whole story, according to Jim Canzler, marketing manager of systems marketing at 3Com in Santa Clara, Calif.

"The most constricting part of any type of network server has more to do with disk performance," Canzler says. "Just having a 386 processor doesn't necessarily make a great server."

According to Richard King, president of Provo, Utah-based Novell, Inc.'s Netware Product Division, in a network environment, "one of your main bottlenecks is getting data to and from the network and also to and from disk storage systems." Unfortunately, King adds, the AT 16-bit bus is not very efficient.

Two categories

Canzler says LAN applications involving high I/O fall into two categories: data bases and accounting packages, which use a large number of small files, and applications involving spreadsheets or financial modeling, which would have a small number of very large files.

Ways to improve disk performance include improved disk caching and techniques such as O-Latency. O-Latency permits the computer to read information from the disk out of sequence and, once stored in random-access memory, sort it into the correct sequence.

But both of these methods, in addition to other techniques used to speed disk access, require memory, as does an Ethernet interface. Thus, Canzler explains, "The I/O bus competes with the processor for RAM."

IBM's solution to this problem is the Micro Channel bus, which is implemented on its Personal System/2 computers. The Micro Channel permits the use of arbitration logic, which controls multiple device access to the same bus. With this feature, multiple direct memory access (DMA) devices can use the same bus to access memory.

Micro Channel compatibility is available as an option on the Banyan Systems, Inc. Banyan/CNS file server. This is a 386 file server that can support up to 24M bytes of memory and 32K bytes of memory caching.

At the same time it made its CNS introduction, Westboro, Mass.-based Banyan also made clear its thoughts on where the future of LAN operations resides by announcing a 386 upgrade package for its Motorola, Inc. 68000-based server.

Scott Haugdahl, senior communications engineer for Architecture Technology Corp. in Minneapolis, also predicts that the future of local-area network servers belongs to the 386 — as long as they provide Micro Channel support. Haugdahl says IBM's Micro Channel is the main reason for buying a 386 server rather than going with older 286 technology. · Without Micro Channel capability, he claims, all users are doing is running the old software a little bit faster.

Building block

With the 386, "You have a platform you can build on," Haugdahl says. The 286 is not a platform you can build on because its 16-bit technology cannot support the Micro Channel.

But all the news is not good about the Micro Channel. There have been reports that the original design suffered from radio frequency interference problems, which IBM engineers have only recently been addressing.

And not everyone believes that Micro Channel support is a necessity.

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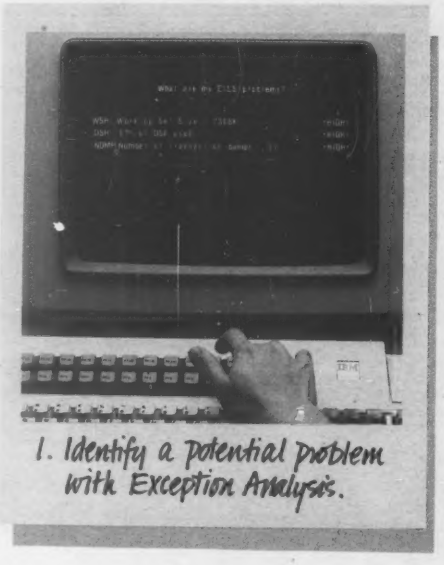

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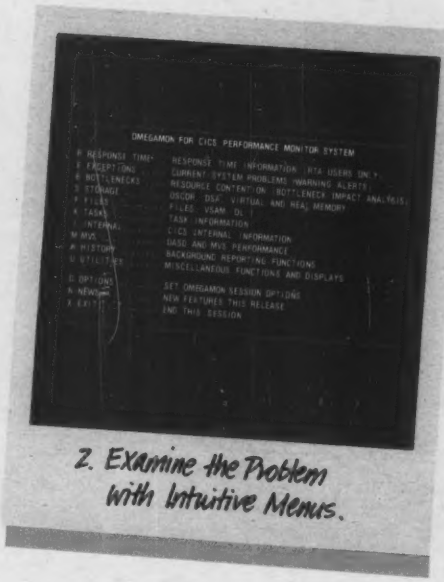

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386 OUTLOOK

While consultant Alex Soya, president of Logan Industries, Inc. in Melbourne, Fla., agrees that one of the major factors in network speed is bus contention among the various server DMA devices, he adds that, "I'm not too convinced that the Micro Channel will be the solution to these problems."

Citing tests that compared the Compaq Computer Corp. Deskpro 386 with the IBM PS/2 Model 80, Soya says the Compaq unit — without the Micro Channel — is the faster machine. Furthermore, these benchmarks did not show much improvement in speed with the use of the Micro Channel, he claims.

Soya suggests that rather than existing to improve performance, the Micro Channel "serves to make IBM's control over the peripheral board manufacturers more complete."

Alternative to IBM

Two of the 386 server manufacturers have designed an alternative to the Micro Channel solution. Both 3Com and Banyan provide a triple-port architecture on their servers to eliminate this contention. With triple-port technology, the CPU as well as the other elements have equal access to memory.

The server and its associated disk are only part of a network, however, and may not be the weakest link in the system's communications chain. Two other elements, the workstation interface cards and the network operating software, must keep up with a 386 server's speed.

"It's the slowest item that controls the speed of the network," Lynch of the Programmer's Shop says. "You have got to get all of the components in a network able to support the speed, otherwise you don't have an advantage."

True 32-bit adapter cards will be necessary for a faster LAN, Novell's King says.

And although 386 computers have been out for about six to eight months, "Most operating systems — even network operating systems — are running in real mode" and not the chip's more advantageous protected mode, King notes. He feels that "some performance improvements are simply because it's a faster machine."

The operating system is another matter, however. King says that Novell has been shipping an 80286 operating system for two years; however, to run the 386 in 286 mode, there is a considerable amount of overhead.

And while 3Com has modified its 3+ operating system for the 386 file server, this software provides little additional capability beyond support for 32-bit memory moves and the use of memory to increase the apparent speed of the disk. 3Com's Canzler says the ability to support 32-bit memory moves only improves network performance between 2% and 5%.

Fine-tuning

Operating system performance is highly dependent on the configuration and typical usage of the LAN on which it is installed, Canzler adds. So, regardless of whether the operating system is specifically designed around the 80386 chip, "Any time you have any operating system, the people doing the installation and management of the network should be knowledgeable about tuning the network."

By adjusting parameters, such as packet size, users can attain higher performance levels, Canzler says.

Banyan is one company that has already developed an 80386 network operating system. Banyan announced its Vines/386 package in the spring of 1986, almost six months before the company's 386 file server debuted.

However, while Vines/386 claims support for the 386 32-bit architecture, it still offers few additional features not found on the standard Vines software.

Chuck Saunders, vice-president of the Riverbend Group, a network value-added reseller in McLean, Va., says it is the lack of software that continues to hold back the power of 386 servers.

He adds that some people are mistakenly waiting for OS/2, which they believe will take

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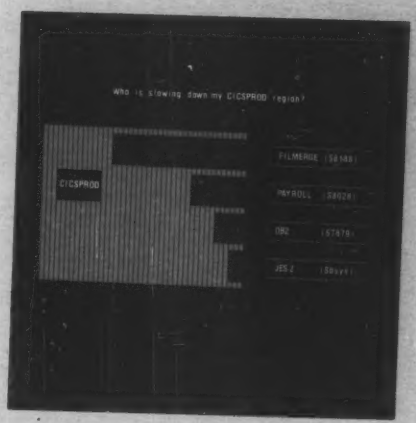

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advantage of the 386's power. Unfortunately, he says, the first version of this operating system does not fulfill this expectation.

The first version of OS/2, which began shipping in December 1987, was written for the 80286 chip.

However, the advantages provided by almost any multitreaded operating system could increase the abilities of an 80386 file server, turning it into more of an applications server.

For example, explains Greg Hansen, senior program manager for Convergent Technologies, Inc., applications programs such as data bases could be split up between both the server and the workstation. Currently, a data base program is run entirely on the workstation CPU, leaving the server's CPU free to handle information requests and manage the network. This setup was a necessity when the limitations of the CPUs left the server with its hands full just controlling network communications. But by using the 386's greater horsepower, data base tasks could be split up between the two CPUs.

Dividing portions

Hansen says that while the workstation portion would focus on the user interface and other high-level tasks, the server portion of the program would perform incoming sort and extraction requests, thus speeding up response time on the network.

Data base developers such as Oracle Corp. and Unify Corp. are working on such projects, and Univation, Inc. in Milpitas, Calif., recently announced its Lifeserver 386 network server. This server was designed to work with the company's Lifenet network operating system, which combines both LAN and data base servers. With the Lifenet system, the data base index is stored at a central location, and the server itself actually processes data requests. This technique also cuts down on the network traffic load because only selected data is passed from the server to the workstation.

Also taking advantage of the 386 are some MS-DOS-like operating systems that have been designed for the 80386, although not necessarily for the LAN environment. These operating systems have both multiuser and multitasking capabilities, allowing a 386-based unit to serve as a host for a small multiuser system.

With systems such as these, it appears that microcomputing is coming full circle. Microcomputers originally moved computing power away from a central processor and onto the desktop. But with the 386, some applications are moving back into a host-based environment — only this time, the host is a 386-based micro.

With support from the right operating system, the 80386 can emulate multiple 8086 machines. This virtual machine capability makes 386 computers a natural for application in multiuser systems, according to Logan Industries' Soya.

These multiuser systems permit several inexpensive terminals (or, in some cases, just a monitor and a keyboard) to be connected, via RS-232 ports, to a single 386 machine. By using software that emulates MS-DOS, these multiuser systems take advantage of the large existing applications software base written for MS-DOS while adding multiuser capability.

These systems are most often used in vertical market and real-time applications, according to vendors. Because of the high speed of such systems and the relative ease of connecting the terminals to the CPU, applications, such as process or manufacturing control, are increasingly being turned over to the 386-based multiuser system.

Multiuser alternatives

Several operating systems currently provide this capacity for 386 computers, and they are not limited to use on machines designed as file servers.

XMM-DOS, developed by Concurrent Controls, Inc. in San Francisco, is an enhanced version of Digital Research, Inc.'s Concurrent DOS.

Concurrent DOS is an outgrowth of Digital Research's CP/M, the first hardware-independent microcomputer operating system. Concurrent DOS, developers claim, has the advantage of using a multiuser, multitasking kernel onto which a DOS emulator has been grafted. This avoids the problems that other systems face in using a DOS look-alike as the kernel and adding multiusage features.

The Software Link, Inc. in Atlanta also recently announced LAN support for its PC-MOS/386 operating system. Unlike most other systems, PC-MOS/386 supports 32-bit protected-mode operations on the 80386, and at the end of November, the company announced that Novell will be supporting this operating system.

Scheduled to ship in the first quarter of this year, the Netware PC-MOS/386 Support Package will permit multiple Novell Netware sessions to run on desktop computers operating under PC-MOS/386.

While this ability does not provide the advantages of a complete LAN operating system, it does allow the interconnection of multiuser systems with some terminals possessing full 80386 capabilities.

However, these systems still lack the critical backing of an IBM or a Microsoft, and, therefore, are unlikely to become 80386 LAN operating system standards.

In fact, without the software and hardware standards and tools and peripherals to drive them, 386 file servers remain more of a promise of things to come rather than an immediate answer to current needs. ❖

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Circle Reader Service Number 10

No blueprint for SAA

IBM's plan lacks grand design

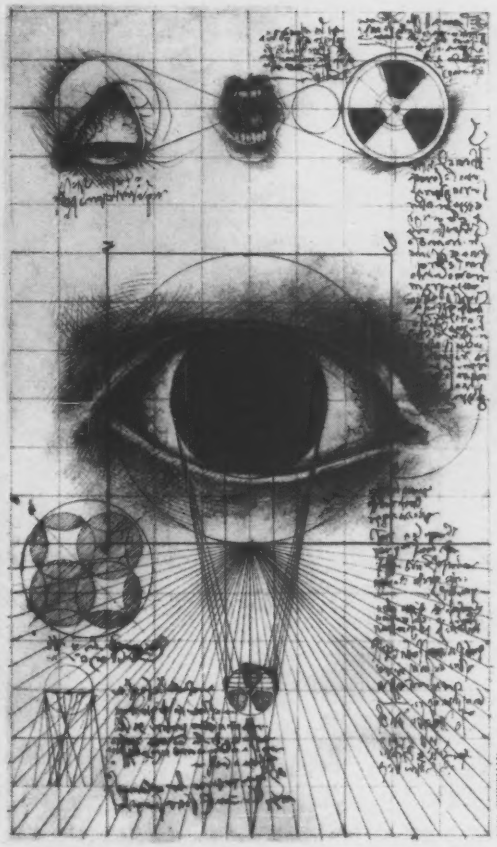
BY TONY PERCY

IBM's Systems Application Architecture (SAA) is currently only a motley collection of products and interfaces that were put together in an attempt to counter Digital Equipment Corp., a competitor that addressed architectural issues more sagely a few years ago, providing consistency, portability and interconnection among its systems platforms. There is no blueprint for SAA. This is not to say that IBM's intent is misguided, only that the evidence of a grand design, which classifies a true "architecture," is simply not visible.

A comparison of SAA with IBM's Systems Network Architecture (SNA) highlights the lack of a master design behind SAA.

Many of SNA's components will also be found in SAA. Even though SNA has changed during the years in response to such factors as distributed processing, intelligent workstations, the need for network management tools and local directories, something permanent has endured. Although their names have changed, there still exist in SNA seven layers that separate the software and hardware boundaries in which decisions should be made about data transformation, routing and so on to gain high-level independence, which is one of the prime goals of a well-designed architecture solution.

As author and lecturer James Martin writes in his book titled *SNA — IBM's Networking Solution*, "Because SNA is an *architecture*, it is independent of any hardware or software product." Certainly, SNA may be associated with certain hardware and software products, and IBM will do its utmost to ensure that SNA users will adopt IBM's implementation of that architecture, but, in principle, users should be able to license or acquire any other vendor's implementation of those protocols or models and not affect the integrity of the total environment.



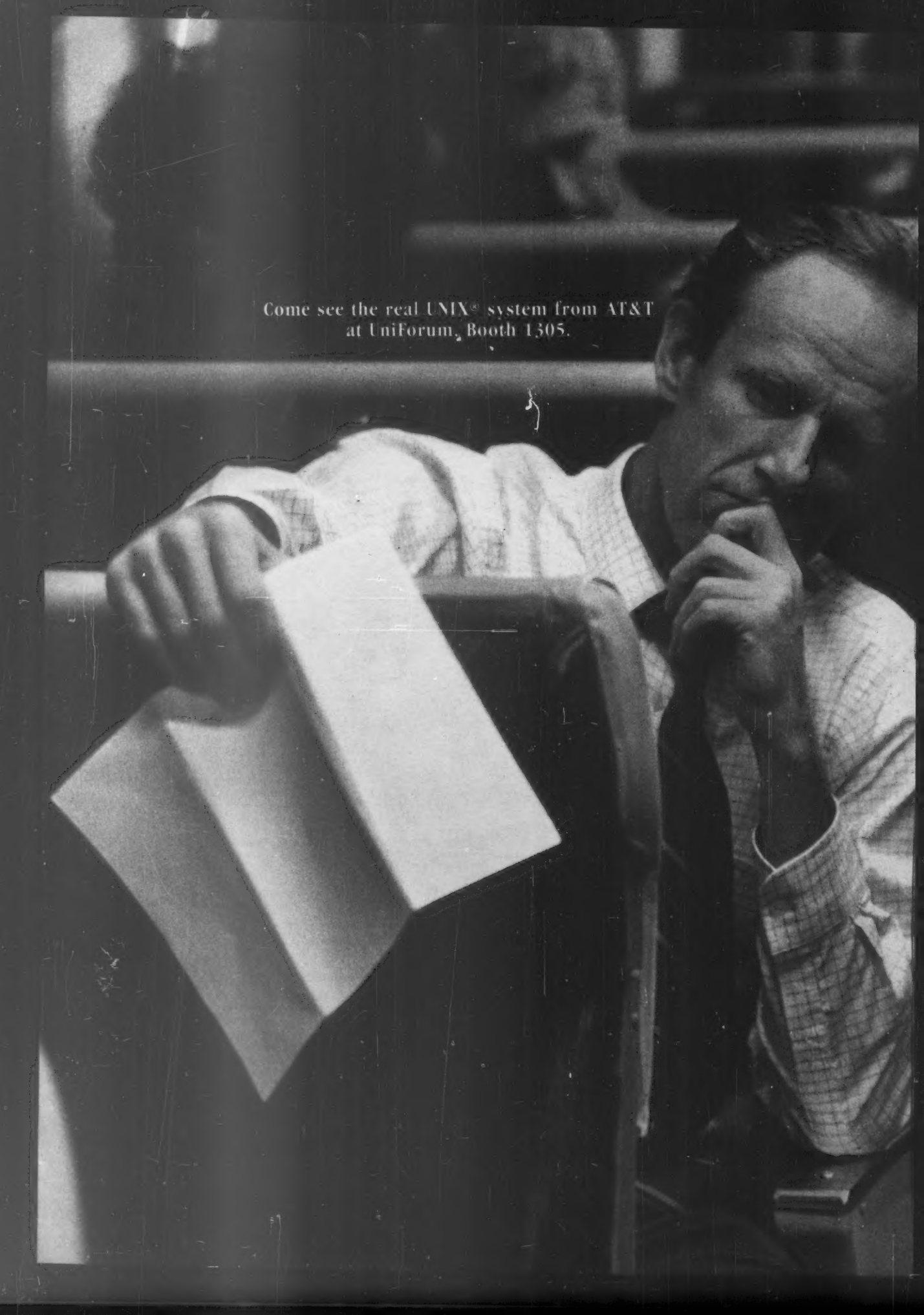
IAN SHEEHAN

For instance, a model of LU6.2 functionality, which covers three layers of the SNA architecture, is successfully supplied by several third-party vendors — especially in non-IBM hardware environments. The degree to which an architecture like SNA is open is the extent to which the protocol boundaries in the architecture are unambiguously and completely defined, thus allowing the recognition of other worlds, the provision of logic to support these worlds and a choice of implementations.

(An interesting and timely footnote to this discussion is IBM's recent signal that the protocols for PU4 and PU5 devices are being removed from the public domain, thus indicating that SNA itself is losing some of its openness.)

SAA is not independent of any particular hardware or software product, although it does contain components that are. The emphasis in architecture should be on the protocols and interfaces, not on products. For an architecture to describe how application systems should be built, even on a single hardware architecture, it should reflect the total scope of what is required to do that. It is not enough for IBM just to address application design as if it were merely a question of a Common Programmer Interface, naming certain third-generation languages to be in SAA that are no surprise to anyone. The company should instead think in terms of a software engineering interface, which would take into account

Percy is vice-president of strategy for Applied Data Research, Inc., a Princeton, N.J., developer and marketer of software. This article is based on a presentation he made at a conference on SAA in London organized by Xephon, a consulting company in the UK.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Nor is it adequate to throw in portions of the interface of a not-very-well-regarded applications development tool — IBM's Cross-System Product — to deflect criticisms that SAA is not addressing the concerns of higher levels of productivity and abstraction and the needs of real-time and transaction processing systems.

The fact is that blatant gaps exist in SAA. For instance, the current definition does not cover the issue of portability of code between different IBM operating systems and teleprocessing monitors, including TSO, VM/CMS, CICS and IMS/DC, let alone between different processors of indeterminate identity, including the System 3X family. (SAA design documentation is vague on some of these issues. For example, "System/3X" is not actually defined, and the suggestion is that it is not in fact a generic name for the System/36 and 38 but a future offering on which components like the Common Programming Interface will be implemented.)

On Oct. 20, 1987, IBM did in fact announce that CICS/MVS and IMS/VS would "participate in the 370 Systems Application Architecture environment." Notice not only the subtle admission that SAA will, in some cases, have to be qualified by "370" (we shall not see IMS/DC under OS/2) but also that IBM announced products, not interfaces.

The remainder of the announcement concentrated on the standardization of interfaces for Advanced Program-to-Program Communications (APPC) for all host SAA environments. While such services will become increasingly important in IBM's scheme of things, they constitute only a small portion of the services that are required of a transaction processing monitor.

IBM may have a tough time convincing users that it has the best vision of what applications should look like and that it understands human factor issues best.

But there are other significant gaps in SAA. More elements are needed to manage the whole cycle of designing, developing, implementing and maintaining applications, especially at a time when IBM is beginning to promote the idea of cooperative processing applications combining logic on a workstation as well as a mainframe.

For example, SAA needs pieces that go toward making a well-engineered application, such as a data dictionary, which keeps track of multiple objects in the organization, especially the meaning of the data in the data base and the way that applications use it.

SAA needs change control and successful methods of tracking change requests and providing audit trails. It needs to address the growing use of higher level graphics techniques to assist in the data and process modeling steps. It must take into account the integration of formal logic rule-based systems, which are beginning to become embedded in certain deliverable applications. IBM must flesh out SAA in a fashion that would achieve credibility and permanence.

Commendable goals

None of these observations are meant to undermine the excellence of IBM's goals. They serve more to point out the severity of the problems facing the company and to highlight the fact that IBM is not performing a service for the software industry by describing SAA, as it is now, as an "architecture." And yet there exist pieces of SAA that reflect tangible technological goals that IBM can achieve.

The difficult part in analyzing IBM's goals for SAA is trying to pin down the reality in the company's announcements and statements of direction.

It is important to keep in mind that IBM devised SAA to address its incompatible hardware and software environments.

IBM appears to have five main objectives in its SAA strategy, as follows:

- To impose greater software engineering discipline in its own development organization to increase productivity.
- To counter the DEC threat by stressing its long-term plans for consistency, portability and interconnectivity in the IBM world and thus regain account control.
- To convince System/36 and 38 users that they have a future with IBM equipment.
- To increase the ability of third-party software vendors (primarily application software vendors) to offer quality products that make IBM hardware and operating system packages more attractive to the industry.
- To develop better human-engineered products that allow and encourage the rapidly increasing end-user community to use a variety of IBM product functions to address business tasks.

The first goal is a straightforward and obvious one. IBM has to reduce the multitude of tools and techniques that have been used in all its development laboratories. Common Programmer Interfaces are a partial means by which to achieve that end.

The second, third and fourth goals are inevitable and uncontroversial because IBM has to move to simplify and reduce variety at a time when the industry is demanding much greater connectivity from its data processing investments.

It is the fifth goal, of improving the human engineering of products, that is in many ways the most subtle objective as well as the one that may spark the most debate.

This goal, which concerns the human engineering aspects of an architecture and is covered in the Common User Access, shows that IBM has finally realized what it will take to derive an increasing proportion of its revenue from software.

Because the company has not provided a statement on the nature of the applications that SAA will support, IBM lays itself open to the charge of dithering.

IBM has to gain a far greater degree of acceptability from the growing end-user community. One of the ways to achieve acceptance is to present a more consistent metaphor for end-user access to a wide range of IBM products.

End users need to acquire an instinctive feel for how a system should behave and learn skills that can be immediately transferred to other products.

Where the user fits in

User needs are the other side of any architecture. Fred Brooks, a leading project manager for the original IBM 360 operating system, claims in his book, entitled *The Mythical Man Month*, that "architecture must include engineering considerations so that the design will be economical, but the emphasis in architecture is on the needs of the user, whereas in engineering the emphasis is on the needs of the fabricator."

On the part of SAA that deals with the Common User Interface, IBM is clearly concerning itself with important human engineering issues.

An interesting development to watch will be the extent to which the market decides that the IBM method of presenting applications, Help facilities and the like, with all the semantic and syntactical consistency it involves, gives users the system quality they need.

Moreover, the flexibility users desire may run counter to the standardization implicit in the SAA user interface. Regardless, IBM's goal of simplification is praiseworthy.

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One last point here is particularly intriguing. IBM has stated the following: "The Common User Access is still evolving. It is being created for intelligent workstations and will grow through the mid-range to the mainframe systems."

Such statements and the lack of coverage of IBM's 3270 software environment in announcements seem to endorse the view that the key to SAA's portability will be through the delivery of systems that have an intelligent workstation, namely the Personal System/2 with OS/2 Extended Edition, as the sole interface.

Noteworthy as IBM's strategy may be, the company will no doubt encounter some problems in executing it. For one, the task of delivering portability and performance is enormous in principle, in practice and in view of IBM's disparate architectures.

As Mike Braude, analyst with the Gartner Group, Inc., a Stamford, Conn.-based research company, points out, "Software portability is a . . . phenomenon like bug-free software that can only be achieved at great expense." It is entirely possible, of course, to deliver identical externals to a product using completely dissimilar and unportable code. That situation might constitute good human engineering but poor software engineering.

Confusion caused by the lack of comprehensiveness of the original definition may cause IBM to stumble. IBM is subject to many internal pressures to include in SAA a number of interfaces (products) that are deemed by their promoters to be strategic. IBM could get caught in a web of its own making if elements not included in SAA are suspected of not being strategic.

SAA's repertoire

Because anything that generates revenue for IBM is considered strategic, the company cannot afford to let the wrong signals go out. For example, VSE is considered by many to be dead because IBM has been dropping hints about its demise for some time. However, not every product that currently fails to appear on the SAA song sheet is necessarily defunct.

Likewise, whenever IBM makes an announcement — most likely accompanied by the press heralding the debut as a further step in the unrolling of IBM's SAA strategy — every interface and feature will be inspected in case IBM is revealing some new offering that will become incorporated in the three target environments of SAA — the 370, the System/3X and the Personal System/2 line. This perception may not always be true, however.

Similarly, IBM has to be careful about stating openly what products (interfaces) have been definitely discarded in SAA planning, such as PL/I, as opposed to those that are still under serious consideration, such as RPG-III.

Problems may also arise from complaints by an existing user base that may resist the incompatibilities that SAA involves or its performance costs. IBM may have a tough time convincing users that it has the best vision of what applications should look like and that it understands human factor issues best.

Dealing with a set of changing technologies, a moving target of sorts, may also cause some problems for IBM. Because the company has not provided a statement on the nature of the applications that SAA will support, IBM lays itself open to the charge of dithering. And dithering it may be, in some cases.

Its shuffle with the much-rumored Repository project and its irregular wooing of the American National Standards Institute IRDS standards committee for data dictionaries are indicative of IBM's uncertainty. The role of graphics techniques in data modeling and high-level code specification is another area in which IBM needs to do a great deal of research before committing to a direction. The strategy for the intelligent workstation push is not yet clearly refined.

The confusion factor

All this does not mean that IBM will be unsuccessful. Confusion in the market often works to IBM's advantage, especially if the independent software suppliers are the target. However, with DEC as a competitor, confusion may be a liability.

So what can we divine from IBM's moves, and how can we expect the company to fill in the gaps in SAA?

First of all, the full implementation of SAA will take years. Further definition will be a slow, staged process, reflecting strenuous debate within IBM. Most experts are predicting it will take until the early 1990s before interfaces will be mature enough to allow the portability that is IBM's goal with SAA. (And by then, of course, the PS/2 with OS/2 Extended Edition will have replaced the 3270 as the primary interface to the system, simple voice recognition systems will be practical, and all the ground rules will have changed.)

Second, there will be simplifications at the higher levels of function invocation that will conceal the lower level divergence. For instance, much has been made of the fact that the Token-Ring network is visible within SAA but that a software interface to exercise it — Netbios being the existing interface — is conspicuously absent. Netbios will nevertheless be around for some time yet, but expect to see an extension of IBM's session management protocol, APPC, to cover a wider variety of functions.

Third, the fate of the System/3X family will be unveiled with the announcement of IBM's Silverlake product. The offering will presumably allow some System/36 and 38 emulation on a 370-based hardware architecture.

Fourth, look for a simplification of the end-user interface and a three-level definition in SAA that will allow menu selection, mnemonic use of the displayed menu and a command language to be simultaneously available at all times. IBM is also expected to make a formal statement to suggest a standard for the meaning of commands across different products or functions.

Fifth, expect a healthy debate on the merits of the the PS/2 as a replacement for the 3270. Look for IBM announcements in 1988 that make substantial additions to the SAA definition and that likely incorporate specialized methods for exploiting the capabilities of intelligent workstations.

Sixth, do not await a reprieve for VSE. IBM has stated, "Our direction with regard to VSE is to make those changes that will facilitate migration to MVS." Do not be surprised by an announcement of MVS/IS on the 9370.

Seventh, do not expect a speedy resolution to the issue of portability across operating systems and telecommunications monitors. It is unlikely that the problem can be successfully attacked by elevating the interface to a higher level, such as CSP; the same problem would remain below. Many experienced software engineers have grappled with the problem of providing a common service interface for applications that would deliver functionality and performance across such systems as CICS, IMS/DC and VM/CMS.

Alternatives will arise

Finally, look out for rival approaches to the idea of an application architecture. Some industry groups may work on an alternate definition or a rival standard to SNA, like the International Standards Organization's Open Systems Interconnect. SAA simply cannot fit the bill in its present shape.

IBM has pulled off a remarkable marketing coup. The company has taken a serious competitive disadvantage — lack of homogeneity — and elevated it to a positive, strategic issue that could delude many into thinking that the company is a safe haven at all times for software as well as hardware.

The worthiness of what IBM is trying to do must not be allowed to distract attention from the poverty of substance in what has been described so far in SAA. The benefits of a well-defined architecture will come to users when they are able to pick and choose components to perform the job.

The opening of the architecture or the proposal of alternative architectures will be threats to IBM. For as long as it owns the architecture, IBM will make every attempt to lock its users into its own components. That is not what makes for a healthy and competitive software industry. ❖

MIS strategies for SAA survival

ALL THE INFORMATION and speculation about IBM's Systems Application Architecture (SAA) can leave many an MIS professional bewildered. The following are some tips that may help you survive IBM's moves.

Each information systems manager must attempt to define the architecture of his information portfolio, keeping in mind what IBM has outlined. He should take inventory of the systems he has developed and acquired, the software packages he licenses, the data bases and files he maintains, the interfaces and security systems he utilizes, the communications links he has adopted and the equipment for which he is responsible.

This task should not be merely a tabulation but an effort to make sense of the choices in order to relate them to what SAA or any other architecture could offer. These actions will help MIS make better decisions in the future.

Information systems professionals should take nothing for granted and demand the most from IBM.

SAA is addressing serious issues, and the IBM user has a right to ask some tough questions and require some sound answers about the substance of SAA.

To plan how components of SAA might be most useful, MIS managers should appoint someone to maintain expertise in the details of SAA as it is unrolled and relate them to the organization's own strategic information plans. There should be no hesitation in attempting to influence IBM about the realities of software architecture.

MIS managers should test their vendors' understanding of SAA's strengths and weaknesses. They should develop ideas of what is immediately useful and why and ensure that vendors are not either following the letter of SAA slavishly or ignoring it completely.

MIS should ask software vendors about their views on architecture and what their stance is on an alternative open systems application architecture.

Above all, information systems people must continue to focus on business needs above technology. They will continue to feel the pressures of squeezed budgets and end-user demands for more.

The success of the strategic systems that MIS delivers will have to address the dual goals of software engineering and human engineering.

MIS will have to stay aware of the acceptability of the human interface and integrated help and training systems and relate the systems it delivers to all the other external services to which the intelligent workstation user will have access.

Professionals will continue to have to make compromises and manage expectations skillfully to maintain productivity at modest expense. Most importantly, MIS managers must realize that when IBM says that a product is "strategic," it means that it is strategic for IBM, not necessarily for its customers. —TONY PERCY

The fate of 4GLs

Hard-to-define, they fight for credibility

BY STAN KOLODZIEJ

The identity crisis for fourth-generation languages (4GL) is going to get worse.

The fact is, 4GLs have never been a particularly easy animal to define. Unlike most computer technologies, which have sought to refine their identities through the work of official standards committees, the 4GL market has been left fairly free to police itself. The result, however, has too often meant a semantic squabbling by 4GL vendors, which has left many users confused and which has put a damper on 4GL sales.

"It's the old story with 4GLs," says Frank Vafier, executive vice-president of Jyacc, Inc., a New York-based developer of user interface systems. "4GL is a generic term that is used by vendors to describe a lot of things that do not conform with American National Standards Institute standards.

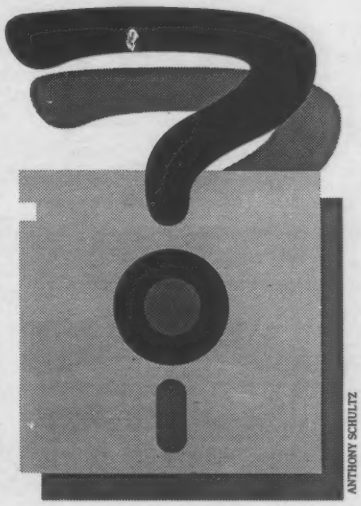
"4GLs are a catchall. They are supposed to be nonprocedural and nonsequential, yet many so-called 4GLs are blatantly neither," Vafier claims.

Definitions aside, another problem with 4GLs has been the inability of users and vendors to properly segment the shifting 4GL market into two broad but important categories.

"4GLs can be broken down into those systems that provide tools for some heavy applications building and those that provide what amounts to fancy end-user query and reporting routines," explains Adam Rin, vice-president of product management at Bachman Information Systems, Inc. in Cambridge, Mass., and who was previously involved in developing Applied Data Research, Inc.'s (ADR) Ideal fourth-generation language system.

Peter Levine, vice-president of software engineering strategies at the Gartner Group, Inc., a Stamford, Conn., research firm, agrees. He calls the end-user-type 4GLs "information generators," which are in contrast to the true fourth-generation language applications generators.

In other words, Levine says, such products as Telon from Pansophic Systems, Inc. in Oak Brook, Ill., Pacbase from CGI Systems, Inc. in Pearl River, N.Y., and Intelagen from On-Line Software International, Inc. in Fort Lee, N.J., are true applications and third-generation language code generators built for programmers. Other fourth-generation systems, such as Focus from Information Builders, Inc. in New York and Natural from Software AG of North America, Inc. in Reston, Va., are end-user systems that do not generate Cobol code for big programs but rely on 4GLs to provide efficiency gains in the front-end design and prototyping stages of the application life cycle.



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Of course, most 4GL vendors are still reluctant to position themselves in either one or the other 4GL camp, a move that could preclude gaining entrance to the lucrative market of the other group. Most 4GL vendors, therefore, claim their systems can accommodate both end-user report generation and heavier systems development. In the past, however, that approach has sometimes led to well-publicized systems development blunders that have fueled user suspicion and the feeling that 4GLs do not belong in the mainframe development arena.

"I think much of what has been said about the failings of 4GLs in heavier systems development is true," Levine claims. "As a result, though MIS has been a big supporter of 4GLs, these languages have mostly been used on a satellite basis. MIS continues to use 4GLs not for the blood-and-guts kind of applications but for lesser concerns."

Vafier says flat out that he doesn't feel it is possible to write complete applications with nonprocedural languages.

"You just can't get the same kind of throughput that you can get with more traditional languages like Cobol," he says. "4GLs are not for big systems."

The larger fourth-generation language development systems have their champions, however. "We're using two 4GL systems to handle

Kolodziej is *Computerworld Focus*'s senior editor.

some heavier, systems-oriented programming," explains David Nickolich, a productivity specialist with a large Midwest communications company. "But we're also using them to give end users access to mainframe data."

Chris Cummer, senior program analyst at Freeport, Maine-based retailer L. L. Bean, Inc., says the company has been using ADR's Ideal for writing nearly all new in-house systems, which include heavy throughput on-line applications like order processing.

The manager of product services at a large southern U.S. soft drink manufacturer says the firm recently shifted from PL/I to Cobol as its primary development language. The manager, who wished to remain anonymous, says his company has since been grinding out large systems development applications using a combination of Ideal and Cobol.

Nod from programmers

Hans Morkner, president of Codd and Date Consulting Group in San Jose, Calif., claims that fourth-generation languages have lately gained in popularity with programmers doing large systems development, especially programmers in big financial companies.

"There is a need to churn these financial programs out quickly, and you can't do that working with Cobol or Fortran," Morkner says.

Nickolich explains that although it is hard for programmers to visualize set processing (a term that he equates with 4GLs and that can be compared with traditional third-generation language sequential processing), it is 4GLs' set processing that can pay major programming benefits later.

E. Reed Doke, an associate professor in the computer information systems department at Springfield-based Southwest Missouri State University, says his field studies of Fortune 1,000 companies revealed a change in the way these companies are designing and developing their software systems.

"There is more end-user input, more end-user software development and more utilization of end users in the development cycle," Doke claims. "We found that, in 1987, between 60% and 77% of the study respondents were using some form of prototyping, and the comments made to us revealed that most of those companies were using 4GLs to do the prototyping."

Doke compares his study with a similar one undertaken at the University of Minnesota in 1981 in which it was revealed that only about 33% of Fortune 1,000 companies were conducting prototyping in 4GLs for new software development.

Doke's findings concerning greater end-user involvement in software development strikes a familiar cord from 4GLs' past.

"These languages have shifted focus into larger, vertical systems development," Codd and Date's Morkner says. "They have never met their stated goal of becoming true end-user programming languages."

However, fourth-generation languages have, in fact, reached this goal for many users. According to Charles Brust, supervisor of computer applications for Montgomery County, Md., "That's what these tools were intended to be used for — producing applications for end users who use mainframe data."

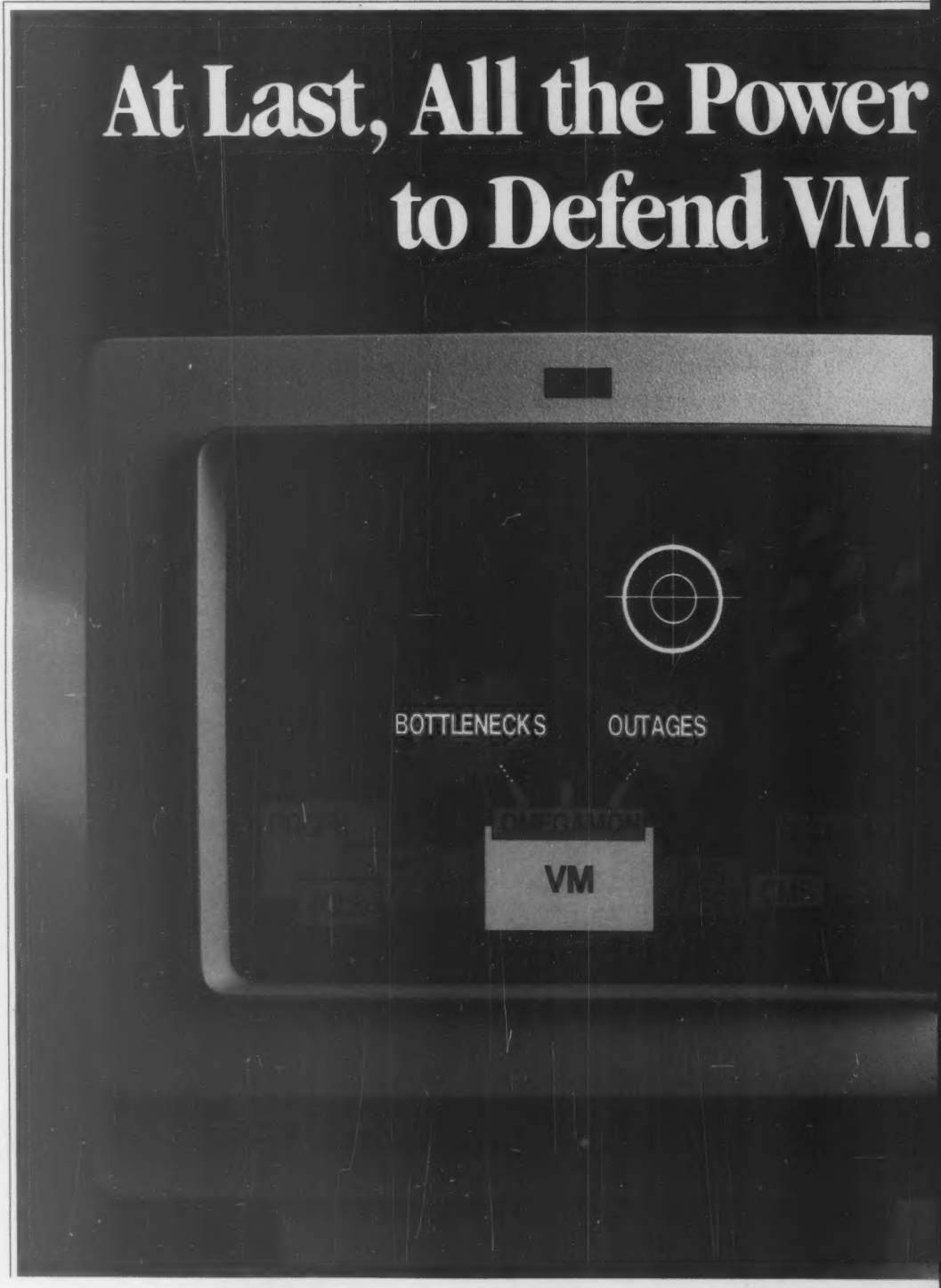
The Gartner Group's Levine says that although he feels 4GLs have not fulfilled all their promises of end-user computing, it is probably because those goals were unrealistic from the start.

Not so shabby

"The major success story of fourth-generation languages on the end-user side has been the creation of facile on-line report generation that has become widespread throughout U.S. corporations," Levine explains. "That's not a shabby record."

Maybe so, but why have 4GLs failed in their mission to bring real programming capabilities to the corporate masses?

Nickolich says the answer to that question is simple. "For all this talk about nonprocedural and English-like statements, end



users still find most 4GL access languages difficult to work with," he says. "You still really need a knowledge of data bases and how they're structured."

For those users who are not capable of or do not wish to get inside a software system and look around, Nickolich explains, 4GLs are an obstacle.

"Yet 4GLs are still the best end-user programming option on the market," says Michael Cohen, a research analyst at Input, a Mountain View, Calif., research firm. "For all the talk about computer-aided software engineering, it leaves the end user out in the cold."

> **"4GLs will be driven by artificial intelligence. We'll see more 4GL vendors integrating extremely user-friendly interfaces."**
>
> HANS MORKNER
> CODD AND DATE CONSULTING GROUP

The mention of computer-aided software engineering (CASE) is significant. Under the current market push of other, better defined software technologies, which include CASE, relational data base management systems, expert systems and some other technologies that claim artificial intelligence as their touchstone, much of what is claimed as 4GL technology is in danger of being broken apart and recast in the image of these other systems.

When speaking with users, analysts and vendors, it quickly becomes clear that most agree that 4GLs will undergo some substantial changes in the near future and that these changes are directly related to the other technologies. Just where the transformations will lead, however, is anybody's guess.

"4GLs will be driven by artificial intelligence," Morkner explains. "We'll see more 4GL vendors integrating extremely user-friendly interfaces, such as Artificial Intelligence Corp.'s Intellect interface."

Nickolich agrees, saying it will be essential for 4GLs to incorporate an easy-to-use interface or to be front ends to relational data bases, which are inherently easily understandable for users.

Levine says that 4GLs have to go beyond the use of the IBM 370 architecture as their main platform, maintaining their front-end software positions and embracing IBM's DB2 relational data base management system or, perhaps, some other relational system like Ingres from Relational Technology, Inc. or Oracle from Oracle Corp.

"These languages also have to incorporate interesting technologies such as natural languages and hooks to expert systems," according to Levine. "Otherwise, they'll be left behind."

Wise choice

According to Chuck Riegel, product manager at Software AG, "At a certain point, we asked whether we should go out and buy other data bases or expand and improve on our existing Adabas data base. We decided to stay with what we had, and it was a wise decision."

Riegel, however, says his company also realizes that there has been a good deal of end-user evaluation of the pairing of 4GLs with DB2.

"We're introducing a DB2 tie-in with our 4GL, but we're going to make sure that we still provide more than what Cobol gives with DB2," Riegel says.

For Carolyn Green, manager of information management at Houston-based Pennzoil Co., fourth-generation languages will become components of fully integrated CASE systems.

"There is so much cross-fertilization in the CASE market now," Green says. "We intend to pilot CASE this year, but we're waiting to see where things settle before making any major commitments."

Hal D'Algee, a consultant based in Davenport, Iowa, says 4GLs are in for a rough time.

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"There has been a lot of AI movement in the last six months," D'Algee says. "A lot of it is within CASE, and that will give 4GLs trouble."

Carnivorous CASE

As an example, D'Algee points to the CASE tools from Bachman Information Systems. And in the estimation of Bachman's Rin, it is just a matter of time before CASE subsumes 4GLs.

"4GLs assume that a data base has already been designed and preexists," Rin explains. "4GLs have basically been positioned as rapid prototyping tools. Where CASE differs is that it is independent of data bases and can convert unstructured Cobol programs. 4GLs are destined to fill part of the CASE environment and eventually fade into CASE."

Input's Cohen disagrees, saying 4GLs are not going away. On the contrary, Cohen claims, it is these languages that will have a major impact on other technologies, such as relational DBMSs.

"All new relational DBMSs have 4GL capabilities, such as screen painting," Cohen says. "4GLs are complementary to data bases, and they are complementary to CASE systems. CASE is not going to eat 4GLs. Both 4GLs and CASE are going in parallel but separate directions and addressing different markets.

"At the end-user level, 4GLs will always offer programming trade-offs in the way of execution time and some loss of efficiency, but that is not why you get 4GLs. If people were always worried about great programming, everybody would be programming in assembler," Cohen says. "The benefits of programming with 4GLs are not always hard and quantifiable."

DB2 ties

But Cohen also says he thinks that 4GLs as an entity will continue to weave their way into other technologies. "One major change is that most 4GLs used to talk only to their own data bases," Cohen says. "Now they are tying into DB2 to remain mainstream."

Andria Rossi, president of Rossi Consultants in Austin, Texas, says that 4GLs are only the beginning of true expert systems. "When you come down to it, all these systems are heading toward the same thing — making it easier to get information out of data bases," Rossi says. "Expert systems are the logical extension of 4GLs."

One area in which 4GLs are making their mark is in the burgeoning market of user interface management systems.

Vafier, whose personal computer-based Jam user interface product is based on 4GL nonprocedural techniques, says that 4GLs are useful as front ends in application development but should back off at a certain point. "Jam programmers build application prototypes, but the applications are actually written in Cobol," he says. "I believe you need to let people keep what they're comfortable with."

Though Vafier says 4GLs are making a significant contribution to user interface front ends, which are necessarily data base independent, his contention that 4GLs lack the abilities for larger systems development makes him pessimistic about 4GLs maintaining their independence. "I see the real definition of 4GLs changing, and I see 4GLs becoming part of other third-generation language-based development systems like CASE," he predicts.

There are other software developments with which fourth-generation languages must contend. As 4GLs edge their way into more advanced software technologies, they may also feel more pressure from some advances made in Cobol, the stodgiest of third-generation tools.

"We avoided 4GLs because we thought they weren't needed," explains David Smith, manager of the productivity aids group at John Deere & Co. in Moline, Ill. "The third-generation application generators or front ends are now giving you the same productivity kicks that 4GLs do."

Drying out

Smith says that his company tried some of the early 4GL report writers on the market and got hung out to dry. "There was no upward mobility with the 4GLs," Smith explains, "and we couldn't target multiple hardware environments like we could with Cobol. There is now a Cobol compiler available for just about every machine on the market."

Doke of Southwest Missouri State also points out that Cobol has had a nonprocedural report writer feature for some time and says some of the nonstandard Cobol compilers on the market, such as Ryan-MacFarland's RM Cobol, are really 4GLs.

But Software AG's Riegel claims there is plenty of room for 4GLs to improve on Cobol, especially at the compiling end.

Riegel explains, for example, that there are still a lot of people using SQL within Cobol to write programs in DB2. "They don't use Cross System Product, IBM's fourth-generation tools, because they're awkward. That leaves few options. What you're going to see is 4GL generators that will generate DB2 programs in IBM DL/1, IMS and VSAM file structures. . . . 4GLs still have enough to stay ahead in the game."

"Given the other advances in the market, however, it looks like the time for 4GLs to really deliver has come," claims David Readerman, a New York securities analyst at Smith Barney, Harris Upham & Co. "4GLs always seem to be one of those technologies in a perpetual state of showing great promise." ✧

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GEOFF O'CONNELL

Small systems give Unix a break

BY MICHAEL TUCKER
FEATURES EDITOR

Commercial Unix, despite everything, is alive.

Five years ago, even the phrase "commercial Unix" was a contradiction in terms. But as we enter 1988, commercial, MIS-oriented Unix actually exists. There is even a movement afoot to bring on-line transaction processing and CICS applications to Unix.

What happened?

To understand Unix's mysterious success and how it might impact MIS, it is necessary to take a look at the short but colorful history of commercial Unix. It is the curious story of an operating system lost among small-system vendors and ultimately strengthened by them.

The fact that Unix is present at all in commercial computing is nothing short of a minor miracle. The operating system was developed at AT&T Bell Laboratories and later refined at universities and research installations as a scientist's operating system. Where it did turn a profit, it did so as the native operating system in scientifically oriented computings.

Then, during the early 1980s, there were several more or less uncoordinated attempts to bring Unix to the commercial world. AT&T, in particular, rediscovered Unix and attempted to promote it.

However, these efforts to position Unix as a commercial offering met with only limited success. "Unix achieved a certain market position," explains Kenneth G. Bosomworth, president of market research firm International Resource Development, Inc. in New Canaan, Conn. "But it was a much smaller share than AT&T would have liked. I suspect that if they had a chance to do it all again, they wouldn't."

Multiuser, multitasking contenders abound. See story page 30.

Perhaps not. But by 1987, Unix accounted for some 9% of

the systems market, according to International Data Corp. (IDC), a Framingham, Mass.-based research concern.

Unix achieved this success mostly because of its multiuser and multitasking aspects and its relatively inexpensive cost.

The early years

The multiuser and multitasking side of Unix was important during the early years of this decade, especially in its Microsoft Corp. Xenix version and particularly with the makers and remarketers of small business computers.

In the early 1980s, there were very few multiuser and multitasking operating systems for developers working at the low end of the market. The various types of Unix fit the bill, and it quickly became, if not exactly the darling, then at least the steady companion of small business computer dealers working in the two- to 10-user range.

It is, in fact, in that same range that you still find the majority of commercial Unix installations. According to Paul Cubbage, associate director of industry services at San Jose, Calif.-based research firm Dataquest, Inc., more than half the Unix licenses in the world are for Xenix.

However, it is also in this range that Unix is most vulnerable. Between 1980 and 1984, Unix was the only game in town. Today, there are dozens of very good multiuser and multitasking operating systems on the market. More ominous is IBM's OS/2. (See story top right.)

Meanwhile, Unix's relatively low cost made it easily available to scores of young, innovative companies. The most famous of these were the technical workstation vendors, but they included a healthy dose of commercial, multiuser microcomputer makers, such as Altos Computer Systems, Inc. and Arete Systems Corp., both located in San Jose.

"Unix is the default setting of anyone entering the system market today," claims William Zachmann, vice-president of corporate research at IDC. "It's the rallying point of anyone who cannot afford a proprietary operating system. These days, that means just about everybody except Digital Equipment Corp. and IBM."

A VAR, VAR better thing

Thus, from its salad days in the commercial world, Unix was the property of small-systems makers. From its time in the wilderness of value-added reseller and small business computer vendors, Unix has gained two important legacies. The first inheritance was a considerable library of applications (this despite Unix's hard-dying reputation for a lack of software). The second was standards.

Chief among the applications and a major reason why Unix has become interesting to MIS are the several robust data base managers that have been written for Unix machines. "Unix began to take off in 1985," Dataquest's Cubbage says. "That was the year when the DBMS vendors got their products solidified and people could build applications on top of them."

Specifically, developers could build applications that could talk to other applications on IBM mainframes. Early in the game, when Unix-based DBMS vendors were struggling merely to survive, they adopted the most radical technologies they could find. Among other things, they picked relational methods of managing data and IBM's SQL as their method of getting at that data.

And so, when IBM introduced DB2, those vendors were in superb position to exploit it. They could offer their DBMSs as departmental extensions of relational, SQL-based mainframe data.

A Belmont winner

Thus, as early as 1984, Informix Software, Inc. in Menlo Park, Calif., (then called Relational Database Systems, Inc.) was promoting SQL as an industry-standard query language. The big winner, though, was Belmont, Calif.-based Oracle Corp., which was able to ride DB2 compatibility into the major leagues of software companies.

Meanwhile, Unix's second inheritance from its small business computer days was an intense, even fanatical interest in standards on the part of its advocates.

Smaller vendors have greater incentives to maintain and enforce some kind of common view of life. After all, these firms may be simply too small to produce all the peripherals, enhancements, software and so forth that users might want. So they must cooperate on some kind of common interface that will allow every vendor to offer as large a selection of third-party hardware and software as possible.

With Unix, this wasn't easy. For the majority of its history, Unix was divided into competing and incompatible variants.

But multiuser standards groups, such as the P1003 committee of the Institute of Electrical and Electronics Engineers, Inc. and X/Open, have become increasingly effective. These groups, and particularly P1003, which promotes its own standard, Posix, have avoided talking about Unix internals and have dealt instead with interfaces. As a result, they have made progress. For example, Posix is not a specification for

Unix's future in the IBM fold

IBM'S POSITION ON Unix is unclear in light of its Systems Application Architecture (SAA) and OS/2 environments.

Big Blue now can offer versions of Unix on most of its machines. However, while IBM seems happy to offer Unix if its customers want it, the company doesn't seem to care to replace AT&T as the leading Unix patron.

The great impact of IBM on Unix could be in the form of SAA, IBM's scheme to link its otherwise incompatible machines across system platforms. Many analysts have pointed out that with SAA, IBM is trying to do within itself what the Unix vendors are trying to do with Posix; that is, create a standard environment in which operating systems would be largely invisible to applications and users alike.

SAA could be a serious rival to Unix. Paul Cubbage, associate director of industry services for the research firm Dataquest, Inc. in San Jose, Calif., says SAA will begin to reduce Unix's market share by 1991.

On the other hand, William Zachmann, vice-president of corporate research at Framingham, Mass.-based International Data Corp. (IDC), suggests that because Unix so easily models other software, SAA would be a "piece of cake to do on Unix." He sees Unix boxes with SAA emulations cutting into IBM's business in the very near future.

And Unix in the IBM world may be in for more worries when OS/2 becomes widely available. While OS/2 is not multiuser in its current form, it is still an attractive alternative to Unix, and there are those who think Unix won't survive the OS/2 invasion.

"Unix will be overwhelmed by OS/2," says Kenneth G. Bosomworth, president of the market research firm International Resource Development, Inc. in New Canaan, Conn. "The real magnet for software developers will be OS/2. The real question for them is if they dare stay away from it."

Bosomworth thinks that even Unix-based scientific and technical workstations are doomed. "As we see the power of the new 32-bit microprocessor released by inexpensive OS/2 platforms, we'll see scientists and engineers flocking to them," he says.

Unix's defenders are quick to disagree. "To say that Unix is doomed is pretty rabid," IDC's Zachmann claims. "OS/2 will certainly play a role, but you don't build a 100 million instructions per second multiprocessor micro and then try to run it on OS/2. I mean, get serious." — MICHAEL TUCKER

Rivals to the Unix kingdom

UNIX ISN'T ALONE. There are a lot of other multiuser, multitasking operating systems out there. Some of them, like Unix, came out of minicomputers, and, like Unix, earned their stripes among computing's value-added resellers (VAR) and dealers and, like Unix, now have a shot at riding multiuser micros into MIS.

Unix's competitors include the following systems:

- **Pick.** The Pick operating system, brainchild of Richard Pick and now marketed by Pick Systems in Irvine, Calif., remains a viable and important operating system in the commercial world. Whereas Unix came out of the scientific world, Pick has been and always was meant for commercial data processing.

  Pick can be found on a number of different systems. In fact, Ultimate Corp. in East Hanover, N.J., currently remarkets the IBM 9370 departmental computer with Pick.
- **Theos.** The Theos operating system is the product of Theos Software Corp. in Lafayette, Calif. Because of its ease of use and other technical merits, Theos has become a great favorite of VARs. "It's great for the vertical marketers," one analyst claims. "You just can't get a better operating system for turnkey systems."

  Whether Theos will make a bid for the commercial data processing field remains to be seen. But it is true that most Theos applications are meant for the bookkeeping operations of small- to medium-size businesses and, as such, look a great deal like downsized MIS software.
- **PC-MOS.** Pick and Unix came down to the 32-bit microcomputers from larger systems. PC-MOS, however, was created expressly for them. Introduced in late 1986 by Atlanta-based The Software Link, Inc., PC-MOS was one of the first operating systems meant for machines based on the Intel Corp. 80386 processor.

  Multiuser and multitasking, PC-MOS has been quickly picked up by developers in search of something, *anything* that would allow them to work on the Intel 386 while they wait for IBM's long-delayed OS/2 offering. — MICHAEL TUCKER

operating systems but, rather, for operating system interfaces. Thus, individual vendors may market quite different operating systems and still be Posix compatible.

Increasingly, vendors can come to the Unix market and find a near approximation of the connectivity they might get in some single-vendor environments.

Thus, the late 1980s finds commercial Unix without any one, dominant patron. What it has is a foundation of multiuser microcomputer hardware and software vendors that have prospered in vertical and small business computer markets.

Clearly, the future of Unix is tied to that community of microprocessor vendors. And rising on their past successes, that community is aiming high. Just how high can be seen in the fact that Unix's partisans are suddenly interested in on-line transaction processing (OLTP).

The fact that Unix should be considered for a role in OLTP applications is astonishing. Traditionally, the operating system has lacked the most basic elements necessary for commercial OLTP — file and record locking. Such was the fatal inheritance of its youth spent in the scientific and technical markets, in which openness was a prime requirement.

Yet, Cubbage notes, it is "particularly there, in OLTP, that we're seeing Unix make an entry." Technologically, it isn't that improbable. Unix was derived from Honeywell Bull's Multics, which, in turn, was developed for large time-sharing systems that looked a lot like modern OLTP systems. As a result, while Unix has kernel-level problems with on-line processing, those problems can be handled by commercial vendors without immense difficulties.

Agree on OLTP

For example, late last year, Pyramid Technology Corp. in Mountain View, Calif., maker of the Unix-based Pyramid line of multiuser micros, and Sybase, Inc. in Berkeley, Calif., producer of the Sybase relational DBMS, announced an agreement under which the Sybase product would be bundled with a new line of Pyramids, the RTP systems, expressly for OLTP applications.

To make the deal possible, Pyramid had to do a lot of rewriting of the Unix kernel.

"Standard Unix isn't friendly at all toward on-line processing," notes Nancy Colwell, Pyramid's data base program manager. "But Unix is also a standard. You can modify the kernel and still keep to the standard."

But it is in terms of marketing that the Pyramid/Sybase arrangement may be most significant. Both companies have been successful before, but the OLTP arena is new to them. When Sybase first came into the world, it aimed at distributed data base markets. Pyramid, meanwhile, has been, by its own admission, a seller of Unix engines and technology rather than applications for most of its history.

In addition, last year Berkeley, Calif.-based Unisoft Corp. announced Unitecs, which is nothing less than a CICS emulation for Unix-based systems. In other words, IBM's own most widely used transaction processing monitor can now be reproduced under Unix.

Currently, CICS isn't even available under IBM VM and isn't expected until late 1989.

Unitecs could be used to remotely develop and maintain mainframe CICS applications on Unix-based microcomputers. Or it could be used to run those CICS applications and so bring IBM-style processing to organizations that could otherwise never afford it, such as small businesses or the departments of large ones.

Unix is being carried forward by the force of its multiple vendors. Little companies, young companies, growing companies are trying to do in bits and pieces what giant corporations were unable to manage in a single, great leap — take Unix into MIS.

In short, Unix is being carried forward by the force of its multiple vendors. Little companies, young companies, growing companies are trying to do in bits and pieces what giant corporations were unable to manage in a single, great leap — take Unix into MIS.

Whether Unix will be more successful in the MIS shops this time remains to be seen.

But what is clear is that the operating system has entered a new phase of its existence. Now Unix is a movement rather than a product. Armed with 32-bit processors, which make micros look so much like minicomputers that it is difficult to tell them apart, and fortified by past successes, micro vendors are attempting to storm the MIS heights. For them, Unix is the glue in their united front. If they succeed, then so shall Unix.

"If you separate hype from reality," Cubbage says, "then what happened was simple. There's been a long, slow growth for Unix. Now it's matured. It's reached the point where people see it as a way of not getting locked into a single vendor." ❖

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SALLY WERN COMPORT

Applications development: Tools of the trade

BY GEORGE SCHUSSEL

Applications builders, from the most sophisticated mainframe-oriented programmer to the end user on a workstation, have different levels of expertise but the same goal — to make applications development a quicker, easier and more strategic process. And these forward-thinking craftsmen rely on the MIS professionals in their organizations to provide them with the wares to get their jobs done. Knowing such tools are available is not enough; matching the solution to the need can make all the difference.

Dividing applications development solutions into four major groups with various subdivisions can help simplify the search process.

Group 1 software tools, which include network data base management systems, fourth-generation languages, Cobol, Cobol systems generators and computer-aided software engineering (CASE) tools, were designed to be used by the professional programmer in complex applications in which the transaction level involved is likely to be quite high.

MIS organizations should have at least one tool set from this category for developing tough, or strategic, applications. Because there are few interfaces currently available between network DBMS/fourth-generation languages and Cobol generator/CASE products, you will most likely have to choose between the technologies.

Group 2 products, which include relational DBMSs, data base machines, indexed DBMSs and programmer-oriented fourth-generation languages, are very effective in attacking medium kinds of problems in which "medium" refers to three things: the skill set of the programmer and data base administrator, the complexity of the application and its volume. In moderately sized organizations, it is likely that a tool set from this group will suffice for building strategic applications. Group 2 tools are also appropriate for larger departmental production systems.

Group 3 software tools, which consist of information center fourth-generation languages and text information management systems, were designed to

Schussel is president and founder of Digital Consulting, Inc., located in Andover, Mass. He serves as chairman of the National Database and 4th/5th Generation Language Symposium and is a fellow of the American Association of the Advancement of Science.

be used by people with some computer experience, not by professional programmers. Many Fortune 1,000 firms have chosen mainframe or personal computer-based information center fourth-generation languages for use in building departmental applications or for general use by non-MIS personnel.

The key here is to make sure that the transaction volume does not overwhelm the software's capabilities. Text information systems are useful in organizations of all sizes that wish to manage and retrieve text with data base capabilities.

Group 4 offerings, made up of such end-user tools as menu fourth-generation languages and executive information systems, were designed for use in departments other than MIS, for data base and file structures that represent historical or time-series data and for analyses in which a spreadsheet's capability is inadequate.

In a broad sense, the list runs roughly in order of increasing ease of use and decreasing ability to handle applications in which high volumes of transactions or complex procedural functionality are required. Because fourth-generation language tools are more specialized than third-generation languages, such as Cobol, developers will need to have more fourth-generation language tools available to solve the diverse problems created by today's sophisticated technology.

First in line

The first category of application development tools — network DBMS, fourth-generation languages and Cobol — is not new; the products are based on Codasyl or hierarchical data models, concepts that have been around since 1970. Examples include IBM's IMS and Application Development Facility, Cullinet Software, Inc.'s IDMS/R and ADS/O, Unisys Corp.'s DMS 1100 and Digital Equipment Corp.'s DBMS 32.

Using a product like IDMS/R with ADS/O gives you access to a powerful integrated data dictionary that can help significantly in coordinating functionality across the various programs of an application. Developing applications with a network DBMS requires programming personnel and a data base administration function. The programming is usually procedural.

The data base administrator will be responsible for generating logical and physical data base designs using several different languages, a process much more tedious than generating data base designs for a relational DBMS. Often, in this environment, the data base administration function can become a bottleneck. High-level screen painting, found in tools like ADS/O, removes much of the need for Cobol coding; if the performance of the generated code is not up to the transaction volume, then Cobol is always available as a backup.

Because products like IDMS/R and DBMS 32 have support for data security and integrity as well as transaction integrity, they are often used for building strategic, transaction processing applications. User demands that range from 30 to 300 transactions per second can be handled by applications developed using these technologies.

Complexity, high volumes

For the programming shop that needs to develop complex high-volume applications, Cobol systems generators provide an alternative, or complement, to network DBMSs and fourth-generation languages. Examples of Cobol systems generators are Transform Logic Corp.'s Transform, Pansophic Systems, Inc.'s Telon, CGI Systems, Inc.'s Pacbase and Unisys's Linc II.

These products include screen painters, DBMS data manipulation language generators, active data dictionaries and Cobol code generators. They normally do not have a proprietary DBMS but were designed to generate data manipulation language code for widely used DBMSs, such as IBM's IMS and DB2 or DEC's RMS and RDB.

When the procedural requirements of the application overwhelm the Cobol generator, one can revert to hand coding in straight Cobol for filling in the missing pieces.

Cobol generators are being enhanced with CASE graphical design front ends. Using the resulting software combination, a user may specify a function through graphical process and data design techniques to a system, which ultimately generates the Cobol or Ada application code. CGI's Pacbase and Knowledgeware, Inc.'s Information Engineering Workbench/Gamma are such products. Other Cobol generators are interfacing with Index Technology Corp.'s much-used Accelerator CASE tool.

There is some evidence to support the contention that Cobol systems generators are particularly useful in building complex applications that would overwhelm normal development methods. An experiment for Unisys conducted by Eberhard E. Rudolph of the University of Auckland in New Zealand using Linc II showed that as the complexity of a program increased, as measured by function points, the work per function point accomplished stayed constant.

Whether with hand coding or with certain fourth-generation languages, the work per function point appears to increase as applications become more difficult.

Cobol systems generators, then, are a good choice for consideration for the largest and most difficult applications. This is a reasonable assumption because most Cobol systems generators require a long training period before programming and development staff achieve proficiency in them.

The software products found in Group 2 — relational DBMSs, data base machines, indexed DBMSs and programmer fourth-generation languages — are suitable for solving many of the same kinds of applications that Group 1 tools solve but with the following differences:

- Group 2 tools are usually used when the performance requirements in terms of transactions per second are less rigorous.
- Group 2 tools are used when the nature of the application may require more retrieval and report processing rather than updating.
- Although using Group 2 tools still requires professional programmer expertise, the investment in training and the complexity of these tools is significantly less than for Group 1 tools.

The relational DBMS tools in Group 2 generally come in two versions: software-only products, such as IBM's DB2, Relational Technology, Inc.'s Ingres and Computer Associates International, Inc.'s Universe, and data base machines from such vendors as Teradata Corp. and Britton Lee, Inc.

Although writing SQL data access code for a relational DBMS still requires some significant programming skills, it certainly is far easier than the comparable function for a Codasyl DBMS or IBM's IMS. Differences in ease of use become even more discernible in the writing of data description language for data base creation, something much more easily done with relational DBMSs.

Weak record

However, software relational DBMSs have a weak record in handling high volumes of transactions. It is safest to target such a relational DBMS to applications that have no more than about 20 transactions per second on the largest mainframes.

Many relational DBMSs come with modern and easy-to-use forms-oriented fourth-generation languages for building on-line applications. Active integrated data dictionaries are another advanced capability found in many relational DBMSs. In cases in which the procedural requirements of the application overwhelm the forms fourth-generation language, Cobol is used with embedded SQL.

One particular flavor of relational DBMS is the data base machine. This facility allows you to run embedded or interactive SQL from a mainframe environment. The processing of the code, however, is not done in the mainframe but is shipped off to a dedicated back-end machine, which searches the disks and provides the front end with the necessary data for the application. Teradata's DBC/1012 and Britton Lee's IDM are the two prominent data base machines.

Both products have proven to be appropriate choices when relational DBMS functionality is desired but the performance requirements are too stiff for software-only solutions. The kind of application that could be well solved by relational DBMSs would be one with a large data base, a high retrieval quotient and the need to support browsing and unanticipated queries.

Indexed DBMSs occupy the middle ground between performance and ease-of-use requirements. They are suitable for many of the same kind of applications as relational DBMSs.

The training curve for building your first application with a programmer fourth-generation language is much less than the time and training commitment required to use Cobol systems generator technology.

Designing a data base with an indexed DBMS is certainly much simpler than designing a Codasyl or IMS data base and is also easier than the comparable task for a relational DBMS. While relational DBMSs require data in normalized form, indexed DBMSs only require simple tabular views.

Among the better known indexed DBMSs are Software AG of North America, Inc.'s Adabas, Applied Data Research, Inc.'s (ADR) Datacom/DB, Computer Corporation of America's (CCA) Model 204 and Compuserve, Inc.'s System 1032.

Most vendors selling indexed DBMSs provide a full product set, including report writers, screen painters and data dictionaries. Also, with the increasing popularity of relational DBMSs, most indexed DBMS vendors have announced they intend to deliver SQL capability in the future.

Because the physical implementation technique used by most relational DBMSs is an indexed DBMS, it is likely that during the next few years, indexed and relational DBMSs will evolve to resemble each other.

Another fourth-generation software tool appropriate to applications of moderate complexity and volume are programmer-oriented fourth-generation languages. Examples of these products include Software AG's Natural 2, ADR's Ideal, McCormack & Dodge Corp.'s Millennium:SDT, Cortex Corp.'s Application Factory and Cognos, Inc.'s Powerhouse. You can build applications using these fourth-generation languages, with their screen painters and dictionaries, without making a commitment to a proprietary DBMS. These products run with the hardware vendor's standard file and DBMS software, such as IBM's IMS and DB2 and DEC's RMS and RDB.

The training curve for building your first application with a programmer fourth-generation language is much less than the time and training commitment required to use Cobol systems generator technology. Programmer-oriented fourth-generation languages are suitable for handling the majority of screen-oriented transaction-based applications in medium-size companies. However, as these applications become larger and their procedural complexity increases, programmer fourth-generation languages do not offer as much support (data and transactions integrity, security and recovery) as some of the tools mentioned in the other categories.

So far, the products discussed are aimed toward the professional programmer in an MIS department as the primary user. What is on the market for the business analyst, or possibly even for the end user, who serves as an applications developer? Friendlier user interfaces and more natural languages or facilities make the use of these products directly possible by the consumer of the information.

Some information center fourth-generation languages are Information Builders, Inc.'s Focus, Must Software International's Nomad 2 and On-Line Software International, Inc.'s Ramis. These products offer English language-like fourth-generation languages with optional embedded proprietary DBMSs. However, the fourth-generation languages run against a great number of standard DBMSs and file systems provided by both hardware and software vendors.

Most information center fourth-generation languages originated from report writers and have been enhanced with significantly increased functionality over time. These products are good choices for building simple applications, departmental computing work loads or personal applications systems. The performance characteristics of typical information center fourth-generation languages,

however, limit their usefulness for larger strategic systems. In fact, any application that will require a throughput of greater than 10 transactions per second is probably inappropriate for these tools.

As long as the application is of low transaction volume and simple data base design, its development can be done by end users.

Products like Focus, Nomad 2 and Ramis do have full-blown programming languages that are also well suited for use by programmers in procedural application development. Still, even in this more sophisticated mode, these fourth-generation languages are easier to master than the functionally equivalent third-generation environment of Cobol, CICS and DBMSs.

Used as a complete procedural language, an information center fourth-generation language may require several months of use before a user can develop expertise. As a result, and in order to appeal to direct use by end users without a programming background, all of these products offer menu- or table-driven front ends that allow the generation of simple applications with a minimal initial training period.

Nonprogrammer fluency

In most cases, within a few days, a nonprogrammer can become conversant using Focus's Talktalk or the Nomad Assistant user interfaces and gain the ability to build simple applications. Someone with a business analyst background but with no programming skills certainly is well within the technological range of this type of product.

Text information management systems were designed to handle bibliographic and library applications. Relational or data-oriented indexed DBMSs are not well suited for handling completely variable-length text or graphics image kinds of data bases. The normal approach used by text information management systems is to do a complete inversion on the data stored so that proximity or exact searches can be carried out on any combination of words.

The data model that best fits text applications is an inversion method, so indexed systems provide the best platform for modifying bibliographic applications. Examples of products providing these kinds of services are Information Dimensions, Inc.'s Basis, Henco Software, Inc.'s Info-DB+ and CCA's Text/204.

The data model used in these applications is usually variable-length text, and, therefore, the data base administrator's job is straightforward. The systems provide query languages and facilities directly and easily usable by non-MIS researchers.

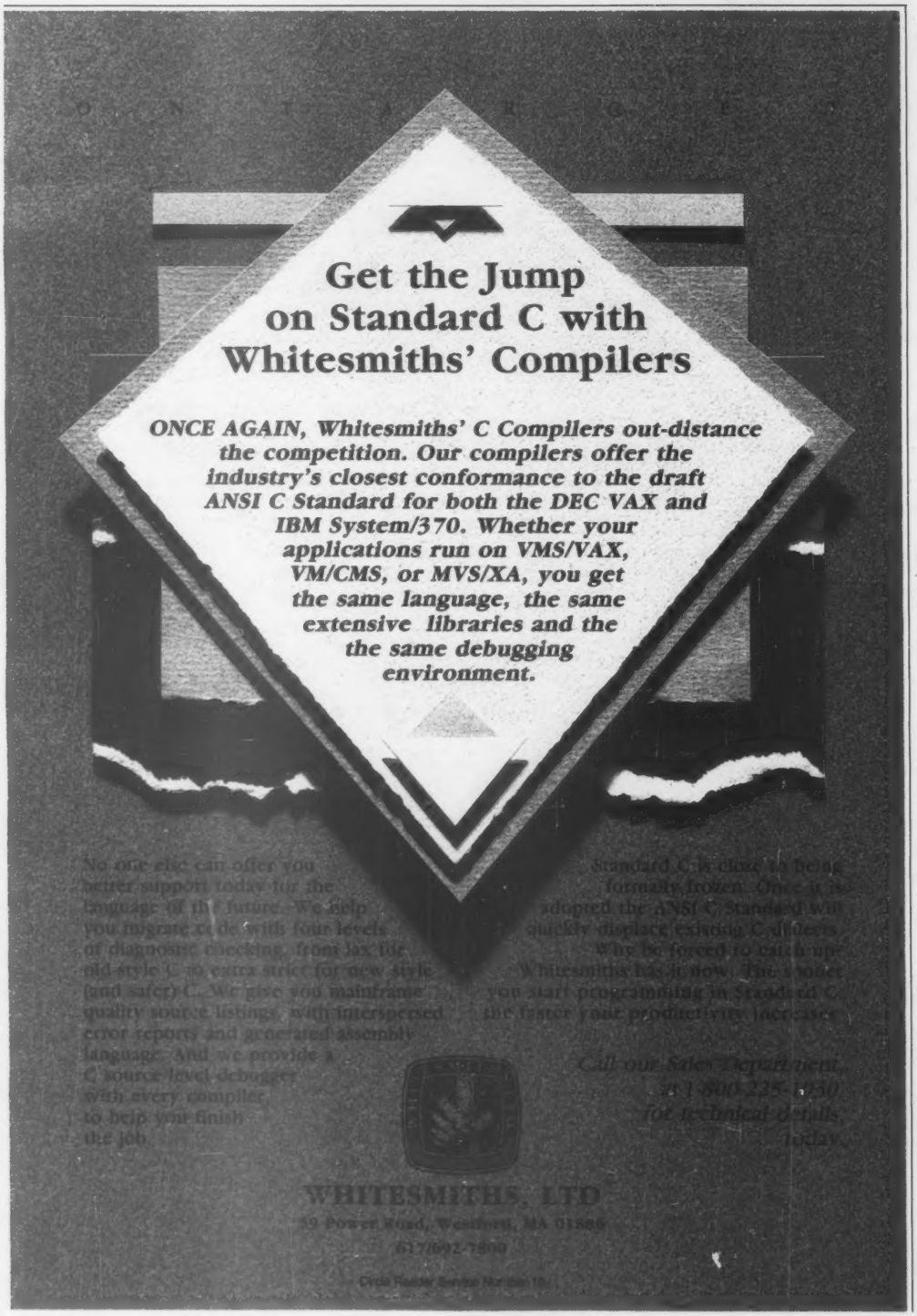
Decision support

Comshare, Inc.'s System W and Information Resources, Inc.'s Express are among the better known examples of decision support systems (DSS). The functions and services provided by these products are similar to those of information center fourth-generation languages.

One way that DSS differ from info center fourth-generation languages is in the way they are marketed. While the buyer of Focus or Nomad is frequently the data processing department of a company, products like System W and Express are usually sold directly to end-user departments, such as manufacturing and finance. The analyses required by these users frequently focus on field, not record, values.

These analyses are also typically performed on existing data bases or historical time series. Accordingly, DSS software is not normally used for interactive, record-oriented transaction capturing. DSS are more useful in multidimensional field-level analyses and reporting in graphic and tabular modes. Because these tools are normally used on static data bases only, updates are typically done in batch mode.

This list of products and suggestions is merely a guideline to help MIS managers provide up-to-date solutions for a range of people. No one tool is right for all occasions and users. As a matter of fact, most firms will probably need several of these offerings to build efficient and productive applications. Good hunting! ‡ ◆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products

TECH TALK

Sun produces Sparcs that may fuel Unix fire

BY MICHAEL TUCKER

Just when you think you've got the future of the microprocessor market predicted, someone like Sun Microsystems comes along and messes everything up.

A few months ago, all the answers seemed to be in. The Intel 80386 was going to be the processor that would dominate microcomputing for the foreseeable future — at least, until the 80486, whatever that is, makes its debut. There would be a few alternative processors, such as Motorola chips or the Inmos, Inc. Transputer, but they would mostly be confined to smaller markets.

Which would mean, of course, that Microsoft's MS-DOS and IBM's OS/2 would shape software as thoroughly as the 386 would shape hardware. Alternative operating systems, and particularly Unix, would drift first into niche markets and then into extinction. It wouldn't be a quick death — operating systems fade away very slowly — but it would come eventually.

Because any vendor can license Sparc, shop for the best price and power.

And all this may yet occur. Kenneth Bosomworth, president of market research firm International Resource Development, Inc. in New Canaan, Conn., argues that the 386-based "inexpensive OS/2 platforms" are so much the wave of the future that developers have only two options: learn to surf or drown.

Bosomworth has particularly harsh words about the technical workstation market. It is, he says, "about to get creamed." Companies like Sun and Apollo are in the same sort of position that makers of dedicated word processors were in a few years back. He claims they are going to be crushed by new, general-purpose computers doing what the dedicated machines were supposed to have done but at a much lower cost. He envisions scientists and engineers flocking to the OS/2 machines in much the same way as office workers before them abandoned their Wang machines for IBM Personal Computers.

He could be absolutely right. Machines with IBM's blessing, running industry-standard Microsoft operating systems and unencumbered by heavy price tags, have a lot going for them.

But that doesn't mean that vendors like Sun have to like the situation or sit idly by as this scenario plays itself out. Consider, for instance, Sparc.

In July 1987, Sun announced that it had been quietly working on Sparc, its own proprietary microprocessor, for several years. Apparently, Sun felt that it could not continue to rely on the architecture provided by the Motorola processors, which were the foundation of its original product line.

That Sun had its own processor did raise a few eyebrows. It isn't easy to develop and maintain your own microprocessor. DEC could do it with the "VAX-on-a-chip" and all that, but, then, DEC is DEC, a very big company that can afford to produce its own processors, its own operating systems and the like. The rest of the world is better off going with off-the-shelf industry-standard components.

Ah, but there's the rub. Sun's people had every intention of using industry-standard components. They just meant to set the standard.

Sparc is, to put it bluntly, one hell of a machine. It is a reduced instruction set computing (RISC) device whose design is linked directly with the father of the RISC revolution, David Patterson of the University of California at Berkeley. In current designs, it is a tour de force in elegant minimalism, sporting a mere 50,000 transistors. This means that not only is it blindingly fast — the initial chips are performing at 10 million instructions per second (MIPS) and above — but it is also scalable.

In fact, that's what the name stands for: Scalable Processor Architecture. It is so simple, so classic, that future versions of the chip can be implemented in new technologies, such as gallium arsenide, without a lot of trouble.

Continued on page 37

Tucker is *Computerworld Focus*'s features editor.

PRODUCT CLOSE-UP

Network CASE tool out

Now, it's CASE for networks.

Sun Microsystems, Inc. in Mountain View, Calif., has recently announced the Network Software Environment (NSE), a network computer-aided software engineering (CASE) system meant for the software developer working on a very large scale, as in the millions or billions of lines of code running on networks of heterogeneous machines that may be located miles or even oceans apart.

As such, NSE would appear to be of only passing interest to most MIS officers. It is clearly aimed at people working on the ragged edge of software development, such as defense contractors and aerospace companies. The product has, in fact, some technological inspiration from the Reston, Va.-based Software Productivity Consortium, a collaboration of high-tech firms in search of increased programmer productivity and new methods of managing large-scale programming efforts.

However, NSE could come to the attention of MIS for two reasons. First, workstations are finding a place in applications outside their traditional scientific/technical niche, including some that fall in the traditional province of MIS. Second, and more importantly, MIS professionals are increasingly working on a very large scale. More and more, their development is done for networks of computers rather than stand-alone machines; therefore, they could find themselves turning to things like NSE to make development on

Continued on page 36

Sybase data base gets natural language interface. See story **page 37.**

BLUE BEAT

Of Ollie and IBM

Deidre Depke

Ollie North, Bud McFarlane, Bill Casey and the rest of those involved in last year's Iran-contra deal were joined by an unlikely partner in their secret activities with foreign governments. History will show that IBM's integrated Professional Office System (Profs) played a pivotal role in the scandal by untangling the web of secret information when the dealings came to light.

Much of the White House staff used Profs to send and receive secret communications and routine information to and from individuals and agencies. Apparently unaware that a computer's memory is much longer than a human's, the players neglected to erase these messages from the White House computer tapes, leaving a long trail of documentation on events that many people thought were long gone. The various lawyers and committees investigating the events found these Profs messages invaluable to their investigations. In fact, as late as Christmastime, revealing Profs messages on the Iran-contra deal were still being uncovered.

As a result, Profs received more than its share of publicity in 1987. One IBM press relations person said recently that he had received more press inquiries on Profs during the latter half of 1987 than he had received during the rest of the system's entire lifetime.

Unwanted or not, the remainder of IBM's software offerings will probably never see the kind of attention that Profs received.

Continued on page 39

Ada precompiler debuts

Embeds SQL statements in Ada programs

Oracle Corp., a Belmont, Calif.-based software developer, has tipped its hat to the Ada programming language by unveiling Pro Ada, a precompiler that embeds IBM SQL relational data base statements within programs written in Ada.

Now edging into the commercial systems arena, Ada originally made its mark with large-systems applications development in the government and military markets. Analysts indicate, in fact, that Ada has been generating more business in all three markets, a fact not lost on Oracle.

"We think that Pro Ada, in conjunction with the nonprocedural query, data manipulation and data definition capabilities of the SQL language, will meet the requirements of complex data base applications, especially those required in the federal government," claimed Dan Klein, product manager for data base management systems languages at Oracle.

Klein said Pro Ada provides full support for the Ada language as presented in the ANSI MIL-STD-1815A standard. He also claimed that the precompiler provides users with integration between SQL and advanced features in Ada. As an example, he explained, Pro Ada supports Ada data-type referencing, including arrays and records within SQL statements.

According to Klein, Pro Ada's support for the array interface enables a single SQL statement to transfer multiple rows of data between the Ada application program and the data base.

The result is a minimizing of overhead for most applications and quick response times for users.

Stellar aspects

The company said that Pro Ada supports its SQL Star distributed DBMS architecture, which enables Ada programs to simultaneously connect with, query and update multiple remote and local data bases.

To run the Pro Ada precompiler, which operates on Digital Equipment Corp. VAX systems running the VMS operating system, users will need Version 5.1 of the Oracle DBMS and the DEC Ada compiler.

Pro Ada's cost ranges from $1,800 for one to nine users; $3,600 for up to 17 users; and $7,200 for an unlimited number of users. — STAN KOLODZIEJ

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Circle Reader Service Number 16

CASE

Continued from page 35

such a scale less an exercise in agony.

According to Sun, NSE is a "generic platform for the support and integration of the software life cycle." The product is said to provide extensive administration, coordination and project management functions in a network. It can, for instance, keep track of huge numbers of modules of code and make sure that developers have access to the most up-to-date version of that code.

However, NSE's most important function may be that it provides a link between other, third-party CASE products running on individual workstations or systems.

With Sun's typical, almost fanatical adherence to open systems, NSE sports a disarmingly high degree of connectivity. The company has displayed the system linking with the graphically oriented systems analyst tool, Teamwork, from Providence, R.I.-based Cadre Corp.

NSE will be a distributed system, running on multiple nodes of a network. NSE is priced at $2,500 and up and is expected to ship in the first quarter of this year. — MICHAEL TUCKER

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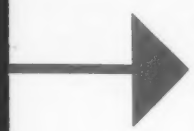

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English-using interface out for Sybase data base

Natural Language, Inc. in Berkeley, Calif., has the ear of Sybase, Inc. Specifically, Natural Language has announced a natural language interface for the Sybase relational data base.

Natural Language makes Datatalker natural language query software. The product allows a user to query a data base in English or something very much like it. Rather than writing an application in, say, IBM SQL, you simply type your requirements in brief sentences, and the system will do your work for you.

Datatalker isn't alone in the natural language field. But it may be the most successful such interface in the commercial market. It is relatively undemanding of computer power. That is a key asset because computers don't like English, or any human tongue much, and to make these machines deal with it usually requires a very expensive hardware and software investment.

Datatalker is both less expensive and more effective than most other natural language software because it uses a combination of traditional natural language processes and artificial intelligence techniques. Many natural language systems consist of little more than a sentence parser mechanism, which is a limiting method of dealing with English. Linguists have long recognized that sentence parsers and diagrams do not accurately describe the way that human beings communicate.

Datatalker goes beyond parsing by including a second level of interpretation — an AI-based concept library and deductive system. If a sentence cannot be understood by the parser alone, it is passed on to the AI portion of the system.

Datatalker still provides only a subset of English, and in the hands of a determined mischief maker, it is easy to confuse. But on the other hand, even a restricted subset of a natural language is a great deal more user-friendly than SQL or even most fourth-generation languages.

Challenge to the elite

Sybase, meanwhile, is the up-and-coming challenger on the micro-based relational data base management system block. It has emerged during the last year and a half as a real challenger to the established data base elite, including Oracle Corp. One of Sybase's primary tools in this competition has been strategic alliances and joint ventures — most recently with firms like Pyramid Corp., which wants to use a data base as part of its entry into the on-line transaction processing market.

The new version of Datatalker could give Sybase an additional edge in that competition.

Datatalker for Sybase is currently available for Digital Equipment Corp. VAX systems and Sun Microsystems, Inc. workstations. It is priced at $10,000. — MICHAEL TUCKER

Circle Reader Service Number 188

PRODUCT CHECKLIST

A product that allows the analysis of VM performance problems using a graphical interface has debuted from **Candle Corp.** Candle, producer of the **Omegamon** VM performance analyzer, said it grafted a **graphical interface** onto the product.

Candle said the interface will allow VM installations to analyze in real time why VM applications are running slow or showing poor response time.

The enhanced version of Omegamon costs $30,000.

Candle, 1999 Bundy Drive, Los Angeles, Calif. 90025.

Circle Reader Service Number 189

VM Software, Inc. rolled out **VMCenter II,** a product that allows VM-based systems to be managed more effectively. The product reportedly provides system monitoring, operating assistance, batch operations control and increased security.

VMCenter II is said to allow users to perform routine data center tasks while regularly monitoring, controlling and reporting on the behavior of VM. In effect, problems can be detected and solved as they occur.

VMCenter II is sold under a graduated license fee, with prices ranging from $25,000 to $88,000, depending on the size of the machine.

VM Software, 1800 Alexander Bell Drive, Reston, Va. 22091.

Circle Reader Service Number 190

Rational Systems, Inc. has unveiled an interactive C compiler that breaks the 640K-byte barrier on Microsoft Corp. MS-DOS-based machines. **Instant-C/16M** enables programmers to more easily handle large programs on personal computers, the vendor said.

Interactive compilers are programs that combine the speed of traditional compilers with the interactivity of interpreters. Rational Systems is known chiefly for Instant-C, an interactive C compiler for the PC environment.

Last summer, the company announced DOS/16M, a protected-mode, large memory environment that allows programmers working with PCs to exceed the 640K-byte memory limitsof MS-DOS. Essentially, DOS/16M does this by letting programmers place applications in memory above the traditional workplace in DOS.

Instant-C/16M costs $795.

Rational Systems, P.O. Box 480, 2nd Floor, 220 N. Main St., Natick, Mass. 01760.

Circle Reader Service Number 191

Wang Laboratories, Inc. has become the latest vendor to display a virtual operating system. Wang announced **VS/VM,** an environment that allows multiple operating systems to run concurrently as virtual machines on a single Wang VS computer.

VS/VM allows these guest operating systems to share main memory, central processing power and I/O devices. It can support up to 15 VS operating systems and VS IN/IX (Wang's Unix version), the vendor said.

The virtual machines are task independent and can all be controlled from a single workstation. Operators can move between them with single keystrokes.

VM/VS is available for all high-end Wang VS 7000 series processors and earlier VS 85 and VS 100 models. License fees are $9,000 to $18,000, depending on the processor.

Wang, One Industrial Ave., Lowell, Mass. 01851.

Circle Reader Service Number 192

Whitesmiths, Ltd. has ported its host-resident **CXDB** interactive C source-level cross-debugger to the Motorola, Inc. MC68000 family of processors.

CXDB reportedly allows embedded 68K-byte programs to be debugged in terms of the original C source code on Digital Equipment Corp. VAX and IBM Personal Computers. It does not require user access to the actual target hardware, and users can access programmable read-only memory debugged code without recompiling, the vendor said.

Other features allow the user to execute host-system commands, print the contents of a C-variable function or file with or without assembly language display, single- or multiple-line step, create log output and set and remove breakpoints.

Prices for CXDB range from $1,800 to $7,000.

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Tech Talk

Continued from page 35

But interesting as all this is in terms of technology, it's the marketing of the product that gets really fascinating. Sun's proprietary chip ain't all that proprietary. In the words of one analyst, Sun has "tossed it over the wall" like an explosive charge into the industry to do with it what it chooses.

Specifically, Sun has licensed the processor to any semiconductor vendor that cares to make it. Currently, the chip can be had as a gate array from Fujitsu Microelectronics, Inc. in Santa Clara, Calif. Meanwhile, both Cypress Semiconductor in San Jose, Calif., and Bipolar Integrated Technology, Inc. in Beaverton, Ore., have announced plans to produce Sparcs in the near future.

Such is the nature of the chip that enables all three firms to sell Sparcs, but the companies won't merely be competing on price. They'll also each attempt to make Sparc run faster or more effectively while retaining the basic Sparc design. It is as if you could purchase 386 chips from multiple vendors, and you could shop around not only for price but also for the underlying technology.

Thus, the Fujitsu Sparcs available today offer 10 MIPS, but the upcoming Cypress version is said to offer 20 MIPS, and the Bipolar version, which is a year or so off, will reportedly have 40 MIPS. Sun is already talking about 100-MIPS Sparcs.

Meanwhile, system vendors that wish to buy those chips and build products around them are free to do so — even if those products compete with Sun's own workstations. As of late 1987, Sun says, some 40 vendors had signed up to purchase Sparcs for one purpose or another, including such firms as AT&T, Xerox and Arete Systems Corp.

These vendors are free to license software from Sun as well. For example, if you want to take a personal computer, develop an add-in board based on the Sparc and produce a source-code-compatible rival to the Sun workstation, you are welcome to do so as long as you pay Sun for the privilege.

And you can get almost anything you like from Sun: the SunOS Unix-derived operating system; compilers for C, Fortran and the like; and, most important, the Applications Binary Interface, a specification for how applications and the environment below them should intersect. The result is that machines from different vendors based on Sparc shall have binary compatibility of software.

A recent issue of Kate Comiskey's "The Unix Perspective" newsletter, a publication of Framingham, Mass.-based market research firm International Data Corp., reports that the Applications Binary Interface is particularly important in regard to Sun's alliance with AT&T. Under the terms of that agreement, Sun and AT&T will work together on the Applications Binary Interface as well as on a joint version of Unix. Comiskey argues that this pact will give Sun the most powerful ally possible in the marketing of its would-be RISC chip standard and give AT&T another shot at being the Unix trendsetter, something that has slipped of late.

Profound repercussions

What all this could mean for Unix as a whole could be profound, indeed. Among other things, Sparc gives Unix vendors a vehicle in which to flee technological obsolescence. By constantly upgrading the chip, yet maintaining binary compatibility between its different generations, developers that use Sparc can stay current without shedding blood in the process. Explains Arete Computer's Chief Executive Officer Gene Manno, "It lets you pursue the cost curve without a lot of hassle."

That being the case, perhaps Sparc will be the method by which Unix can avoid the fate proposed for it by OS/2 partisans. Maybe Sparc will come to define Unix, particularly in commercial computing. Unix vendors have tried lately to bring their wares into on-line transaction processing (OLTP) applications. But OLTP is brutally demanding of compute power. Sparc offers that power, which is the reason why Arete went with it. Doubtlessly, there will be other vendors looking into the possibility of using the chip to produce inexpensive mainframe replacements that would neatly hang on to Sun's already well-developed networking technology.

The important word here is still *perhaps.* Sparc is not the only RISC chip in the universe, nor is the Applications Binary Interface the only Unix standard. Machines running the Intel 386 already have a de facto binary standard for Unix. Meanwhile, Motorola is known to be working on a RISC chip of its own that may be more than the equal of Sparc, and there is an effort to develop a binary standard for Motorola systems.

Yet the Sun chip has some unusual characteristics. Sparc is an open game. Sun makes the rules, but anyone can play. It looks, in short, a bit like the PC in its early days, when third parties created a market that exceeded the original vendor's wildest expectations and fulfilled some of its greatest fears.

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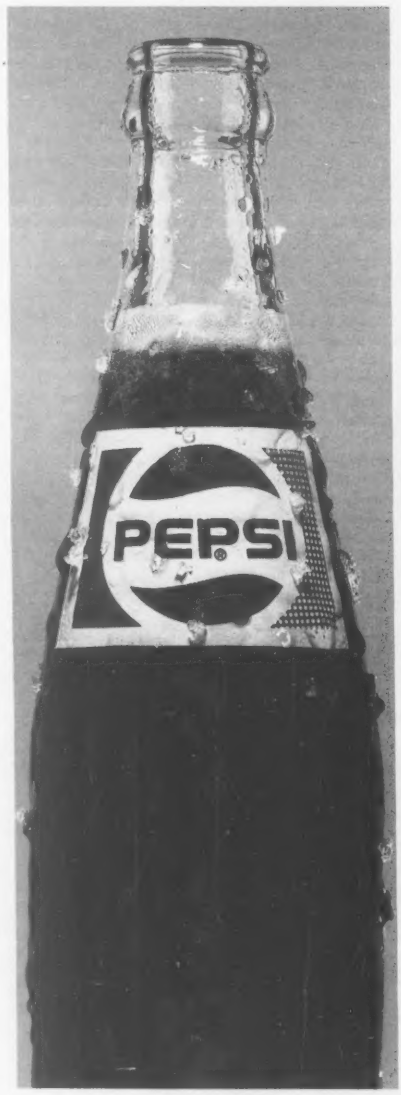

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The Insider

Continued from page 40

Macintosh, Hypercard does not work.

Users seeking that kind of capability for the Mac may turn instead to Modern Jazz, Lotus's latest incarnation of the integrated application package for the Macintosh world. But once again, you must deal with a script language (albeit an extremely powerful one).

In lieu of a natural language end-user programming facility that empowers even the rawest tyro, end users are still being forced to learn one or more macro languages to do their programming. Result? The 80/20 rule that states that 80% of the users use about 20% of the software's power. Vendors still have a very long way to go.

Millikin is vice-president and senior analyst with Patricia Seybold's Office Computing Group in Boston.

Blue Beat

Continued from page 35

For the most part, software isn't considered sexy by the trade and consumer press, which chooses instead to highlight hardware offerings by IBM and others in its industry coverage. The result is that most software rarely receives the type of coverage it deserves — making it difficult for IBM to promote its software offerings and impossible for MIS departments to keep up with the products available.

Advertising software isn't a good solution to this problem. It's difficult for even the most sophisticated advertising firm to promote the characteristics of systems and operating software; the concepts are often too complex to communicate adequately in the limited time the average reader grants an ad.

Obviously, some of IBM's most famous operating software offerings are very well known. VM, MVS, DOS and OS/2 are familiar to end users — at least, in the abstract. But this familiarity doesn't hold true for the majority of IBM's application offerings. It is this majority that composes the backbone of IBM's array of software and that the firm hopes will generate significant revenue through the 1980s and into the next decade.

Promoting software is a problem for IBM. In 1987, it put into place the necessary corporate structure to develop or acquire operating and application software. But with the notable exception of OS/2 (which got so much attention that its actual attributes were lost in a controversy of compatibility), IBM was unable to effectively communicate the work that it had done on its offerings.

It may be somewhat well known, for instance, that in July of last year IBM finally gave software its due by creating the Applications Systems Division (ASD), which is charged with developing application software and consolidating the company's relationship with third-party developers. Some may also know that on the applications side, IBM began to focus seriously on software for niche markets. Health care, financial services and the travel industry were just three vertical markets for which it announced specialized applications. And independent software vendors certainly are aware that IBM also aggressively stepped up its pursuit of third-party resources to meet its promises to vertical markets.

Wheeling and dealing

In 1987, IBM signed scores of leading software vendors to remarketing agreements for vertical market applications. The firm even chose to work on research and development with third parties and signed up Cambridge-based Lotus to develop 1-2-3 products for IBM's 370 system. More such deals are on the way.

But just what ASD is now marketing or will market in the future is barely known. IBM must now find a way to communicate that work to customers and make them aware of the specific offerings available.

It's unlikely that the company can depend on its marketing force to make customers aware of these products. While many salesmen are willing to sell software as part of an integrated solution to customers buying hardware, they are not as likely to go out and make sales calls that stress software only. This is particularly true for smaller applications; the profit margins aren't sufficient to justify the time spent on the sales call. Unfortunately, that makes the problem particularly tough; it is to the smaller installations that IBM most needs to sell the software. Mainframe buyers already have their needs well covered by attentive IBM sales reps.

IBM may have to put into place a dedicated software sales force. These individuals could spend their time pushing application software to accounts with IBM equipment installed. To be most effective, they would have to be organized by industry market — one group could push software to the health care industry, while another could sell to travel agencies, for instance.

IBM must also target brand new customers with its software. These buyers are key to IBM's efforts to improve its revenue. By selling users on vertical market software, IBM can sell them on its hardware. These are the customers who remain relatively unexploited by IBM competitors, and they are markets that, for the most part, could see real improvements in the way their businesses operate if properly computerized. Those kinds of improvements will sell people on IBM and could, in 1988, finally help IBM reach its goal of generating significant revenue from its software efforts.

Depke is the former editor of "IBM Watch," a biweekly newsletter published by International Data Group, located in Framingham, Mass.

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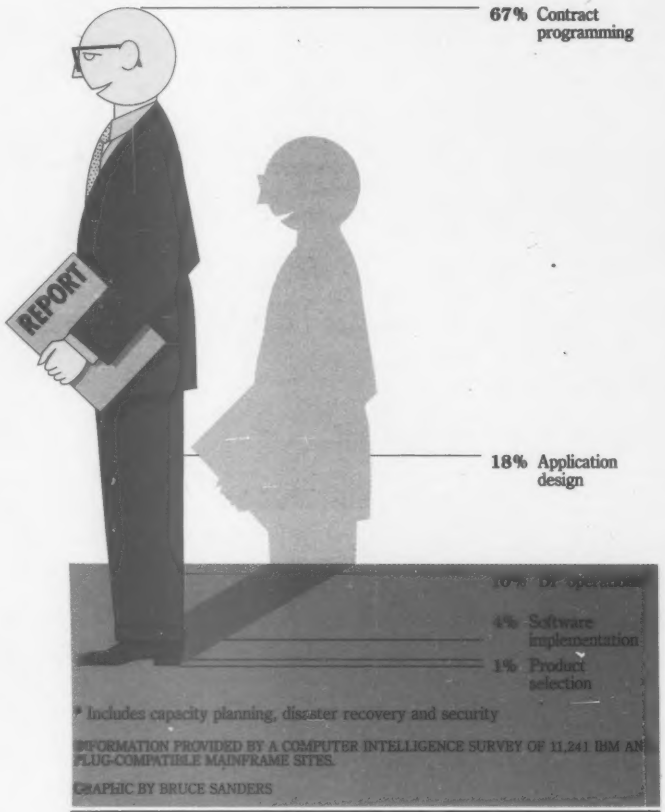
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OF INTEREST

"Computer literacy is the greatest stumbling block to making computers more relevant to people. Graphical interfaces are going to open up computer literacy, and with it, sales."

GEORGE MORROW
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See story page 11

next issue

Spring into departmental computing with the March issue of *Computerworld Focus.* In it, a top industry analyst provides some opinions on the role of MIS in relation to the rise of autonomous departments. In addition, get the lowdown on PC LANs and work group productivity tools. The Special Section will attempt, through case studies, to dispell the confusion surrounding departmental computing's terms and technologies and take a look at how your peers are handling the decentralization trend.

80/20 rule in practice

Michael D. Millikin

End-user programming has always been a hot button. The rationale behind the concept is to empower the average user with the ability to satisfy the majority of his applications needs without burdening the data processing shop. Everybody theoretically benefits. Users get to do their job speedily, and programmers don't have another year's worth of backlog dumped on top of their shoulders.

But what do end users use to program, and how do they do it? A local university has just stricken Basic from its curriculum as an end-user programming language and is teaching Lotus's 1-2-3 instead. Indeed, for many users, Lotus's macro language is the default end-user programming tool. That situation doesn't do much for non-Lotus users, however.

THE INSIDER

Several mini-based vendors, notably Wang and Computer Consoles, have produced good end-user programming offerings. Again, that doesn't do much for personal computer users.

Right now, there is no broad-based cross-application end-user programming facility for the PC environment. And because the PC increasingly is becoming the desktop device of choice, that creates a problem.

Solutions will come in one of two forms: applications based or systems based.

An example of the application environment solution is Lotus's LEAF, or Lotus Extended Application Facility. The obvious drawback here is that you need to be a Lotus application or an add-in to play.

The more broad-based and, hence, intriguing solution is the system-based one. Examples here include Hewlett-Packard's New Wave environment, which is built atop Microsoft's Windows; a hypothetical Windows cross-application macro facility; and Apple's Hypercard.

Yet within this type of solution, consistency, transparency and ease of use vary widely. The HP solution offers the broadest range of capabilities and imbues the process with intelligence, even across applications. (Your applications must in some way recognize the New Wave extensions to Microsoft's Windows and soon-to-come OS/2 environments.)

Microsoft currently offers a nice command macro facility within its Excel that lets the user record and play back. To reach into other Windows applications with dynamic data exchange, however, a user needs to use function macros, which entail working in a Basic-like language.

As for Hypercard, Apple excited a lot of people with its release of this hypermedia-like programming environment that supposedly was to provide programming for the rest of us. Hypercard is exciting and terrific and relatively easy to program within. But it is not, at least in its current incarnation, the answer to end users' prayers. Users end up working with yet another script language, Hypertalk, if they want complexity in the applications they create. As a cross-application programming environment for the Apple

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   65. Communications Systems/Public Utilities/ Transportation
   70. Mining/Construction/Petroleum/Refining/Agric.
   80. Manufacturer of Computers, Computer-Related Systems or Peripherals
   85. Computer & DP Services, including Software/Service Bureau/Time Sharing/Consulting
   90. Computer/Peripheral Dealer/Distributor/Retailer
   75. User: Other _____
   95. Vendor: Other _____ (Please specify)

2. TITLE/FUNCTION (Circle one)
   IS/MIS/DP MANAGEMENT
   19. Vice President, Asst. VP
   21. Dir., Mgr., Suprv., IS/MIS/DP Services
   22. Dir., Mgr., Suprv., of Operations, Planning, Adm. Services
   23. Dir., Mgr., Suprv., Analyst, of Systems
   31. Dir., Mgr., Suprv., of Programming
   32. Programmer, Methods Analyst
   35. Dir., Mgr., Suprv., OA/WP
   39. Data Comm. Network/Systems Mgt.
   OTHER COMPANY MANAGEMENT
   11. President, Owner/Partner, General Mgr.
   12. Vice President/Asst. VP
   13. Treasurer, Controller, Financial Officer
   41. Engineering, Scientific, R&D, Tech. Mgt.
   51. Sales/Mktg. Mgt.
   OTHER PROFESSIONALS
   60. Consulting Mgt.
   70. Medical, Legal, Accounting Mgt.
   80. Educators, Journalists, Librarians, Students
   90. Others _____ (Please specify)

3. COMPUTER INVOLVEMENT (Circle all that apply) Types of equipment with which you are personally involved either as a user, vendor, or consultant.
   A. Mainframes/Supermins
   B. Minicomputers/Small Business Computers
   C. Microcomputers/Desktops
   D. Communications Systems
   E. Office Automation Systems
   F. No Computer Involvement

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QNX vs. OS/2 UNIX

QNX: Bend it, shape it, any way you want it.

ARCHITECTURE If the micro world were not so varied, QNX would not be so successful. After all, it is the operating system which enhances or limits the potential capabilities of applications. QNX owes its success (over 30,000 systems sold since 1982) to the tremendous power and flexibility provided by its modular architecture.

Based on message-passing, QNX is radically more innovative than UNIX or OS/2. Written by a small team of dedicated designers, it provides a fully integrated multi-user, multi-tasking, networked operating system in a lean 148K. By comparison, both OS/2 and UNIX, written by many hands, are huge and cumbersome. Both are examples of a monolithic operating system design fashionable over 20 years ago.

MULTI-USER OS/2 is multi-tasking but NOT multi-user. For OS/2, this inherent deficiency is a serious handicap for terminal and remote access. QNX is both multi-tasking AND multi-user, allowing up to 16 terminals and modems to connect to any computer.

INTEGRATED NETWORKING Neither UNIX nor OS/2 can provide integrated networking. With truly distributed processing and resource sharing, QNX makes all resources (processors, disks, printers and modems anywhere on the network) available to any user. Systems may be single computers, or, by simply adding micros without changes to user software, they can grow to large transparent multiprocessor environments. QNX is the mainframe you build micro by micro.

PC's, AT's and PS/2's OS/2 and UNIX severely restrict hardware that can be used: you must replace all your PC's with AT's. In contrast, QNX runs superbly on PC's and literally soars on AT's and PS/2's. You can run your unmodified QNX applications on any mix of machines, either standalone or in a QNX local area network, in real mode on PC's or in protected mode on AT's. Only QNX lets you run multi-user/multi-tasking with networking on all classes of machines.

REAL TIME QNX real-time performance leaves both OS/2 and UNIX wallowing at the gate. In fact, QNX is in use at thousands of real-time sites, right now.

DOS SUPPORT QNX allows you to run PC-DOS applications as single-user tasks, for both PC's and AT's in real or protected mode. With OS/2, 128K of the DOS memory is consumed to enable this facility. Within QNX protected mode, a full 640K can be used for PC-DOS.

ANY WAY YOU WANT IT QNX has the power and flexibility you need. Call for details and a demo disk.

THE ONLY MULTI-USER, MULTI-TASKING, NETWORKING, REAL-TIME OPERATING SYSTEM FOR THE IBM PC, AT, PS/2, THE HP VECTRA, AND COMPATIBLES.

Multi-User	10 (16) serial terminals per PC (AT).	**C Compiler**	Standard Kernighan and Ritchie.
Multi-Tasking	40 (64) tasks per PC (AT).	**Flexibility**	Single PC, networked PC's, single PC with terminals, networked PC's with terminals. No central servers. Full sharing of disks, devices and CPU's.
Networking	2.5 Megabit token passing. 255 PC's and/or AT's per network. 10,000 tasks per network. Thousands of users per network.	**PC-DOS**	PC-DOS runs as a QNX task.
Real Time	2,800 task switches/sec (AT).	**Cost**	From US $450. Runtime pricing available.
Message Passing	Fast intertask communication between tasks on any machine.		

QNX

For further information or a free demonstration diskette, please telephone (613) 591-0931.

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